PATENT ABSTRACTS OF JAPAN

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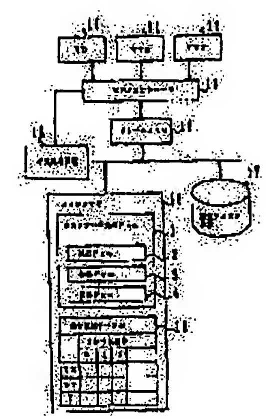
(54) CAMERA WORK DETECTING METHOD

(57)Abstract:
PURPOSE: To accurately detect a camera work and to improve the picture edit processing operation by dividing a picture into many blocks, obtaining a moving vector at each block and estimating a moving parameter.



CONSTITUTION: This method is provided with a program 2 detecting a moving vector from a moving picture stored in a frame memory 14, a program 3 extracting a parameter representing the movement of panning and zooming from the moving vector and a program 4 registering the moving parameter to a movement description table 18. Then a 1st moving parameter representing the movement of a camera is obtained for each frame by using the moving vector detected at a representative point of each block of an optional frame. Then it is integrated until an allowable value is exceeded and the integration value is averaged for an integration block when the allowable value is exceeded to calculate the 2nd moving parameter. Then the movement of the camera is detected by using the parameter. Thus, even when a moving object invades to a pattern, it is accurately detected and the data is used for speed adjustment information at video unit.

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representation point which is in this standard deviation from this average was calculated, it integrates with the average of the called-for zoom scale factor in a continuous frame and the value with which it integrated exceeds a predetermined threshold, The camera work detection approach characterized by outputting to the registration table which records camera work for every frame as a motion parameter of the zoom of the frame section which equalizes the value by the limits of integration, and corresponds the this equalized value.
[Claim 4] the camera work detection approach according to claim 3 -- setting — the motion vector of each representation point of a small block, and the frame in front of a continuous frame — the pattern of an image -- un—— 1 — the camera work detection approach characterized by using a block [like] as a standard pattern and searching for it from a difference with this standard position near the above-mentioned block in the continuing frame.

[Translation done.]

CLAIMS

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(57) [Claim(s)]
[Claim 1] The dynamic image which consists of two or more continuous images is inputted into time series per frame. By this inter-frame one The motion vector of each representation point defined for the small block of every when dividing this frame into a small block is detected. Ask for the average value and standard deviation of a motion vector of each representation point, and the average value of the motion vector of each representation point which is in this standard deviation from this average value is calculated. Integrate with the calculated average in a continuous frame, when the value with which it integrated exceeds a predetermined threshold, equalize the value by the limits of integration, and the this equalized value as the pan of the corresponding frame section, and a motion parameter of a tilt The camera work detection approach characterized by outputting to the registration table which records camera work for every frame.
[Claim 2] the frame in front of the frame which the motion vector of each representation point of a small block follows in the camera work detection approach according to claim 1 — it is — the pattern of an image — un—— — the camera work detection approach which uses a block [like] as a standard pattern, is near the above-mentioned block in the continuing frame, and is characterized by making it ask from a difference with this standard position.
[Claim 3] The dynamic image which consists of two or more continuous images is inputted into time series per frame. By this inter-frame one The motion vector of each representation point defined for the small block of every when dividing this frame into a small block is detected. Ask for a zoom scale factor from the motion vector of each representation point, and a position vector, and it asks for the average and standard deviation of this zoom scale factor. When the average of the zoom scale factor of each

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention searches the dynamic-image frame which makes into the purpose from the dynamic image especially stored in the video tape or the videodisk based on motion (right-and-left [of a camera] , and rotation [vertically]) information , such as a zoom (change of the image pick-up scale factor by migration of the lens of a camera) of a camera , and a pan , a tilt , with respect to the description approach of the scene of the dynamic image which is needed at the time of image edit of video or a movie , and relates to the suitable camera work detection approach to perform image edit efficiently .
[0002]
[Description of the Prior Art] By detecting the changing point of an image automatically from the dynamic image stored in the video tape etc. conventionally, the change of a scene is detected and the technique which makes easy head broth actuation at the time of dynamic-image edit etc. is indicated by Japanese Patent Application No. 2-230930. By using the information about camera works, such as a motion of the video camera itself i.e., the zoom of a video camera, and a pan, further for every scene detected using this technique For example, "I want to see the scene which is carrying out the pan to the left from the right." Or it enables an edit system to support retrieval of a dynamic image, such as "wanting to see the scene immediately after zoom-in", and the editing task of a dynamic image, such as "I want to correct the wow and flutter of a pan", and "wanting to make the rate of a pan quicker." For that purpose, camera works, such as a zoom of a video camera and a pan, are detected, and the technique which describes it automatically is needed.
[0003] Conventionally, as a technique of detecting a motion of the video camera itself, the thing of a publication is in JP,2-157980,A, for example.

This detects vibration of a video camera and amends image Bure. That is, on a screen, about four comparatively big detection fields are set up, for example, with the correlation value in a predetermined deviation, it asks for an inter-frame motion vector, and the motion vector of a screen is determined from the judgment result of the condition of a correlation value, and the dependability of the motion vector before it. When the motion vector by vibration of a video camera vibrates focusing on zero vector and a migration object invades, a motion of a migration object and a motion of a video camera are added, and a motion vector can be found. The motion vector at this time becomes that by which constant value was added to the motion vector by vibration, and separation with the motion vector by vibration is possible for it, and it amends Bure of the image by vibration of a video camera only from the motion vector by vibration.
[0004]
[Problem(s) to be Solved by the Invention] In a Prior art, since the trouble which it is going to solve cannot detect correctly the motion vector which shows the motion which the camera itself carried out slowly, it is a point which cannot detect camera works, such as a pan and a zoom, automatically and cannot perform efficient image edit.
[0005] Namely, oscillating detection of a video camera is the purpose and, as for equipment given in JP,2-157980,A, consideration is not paid to the detection purpose of camera works, such as a pan and a zoom. For example, it judges with that from which the migration object trespassed upon the left with above-mentioned equipment about the image which carried out the pan of the video camera from the right, and is not regarded as a motion of a camera. Moreover, although a motion vector is detected in the direction of a radial from the bottom of its heart among a screen about the image at the time of zoom-in or a zoom down, there is no means to change into the scale-factor value of a zoom from those motion vectors. A motion of a pan and the video camera at the time of a zoom has a rate still slower than a motion of a hand deflection. Therefore, possibility that precision sufficient with the above-mentioned equipment which determines a motion of a screen by one motion detection will not be acquired is high.
[0006] The purpose of this invention is offering the camera work detection approach which solves such a conventional technical problem, detects a motion of a camera from images, such as a pan with a slow rate, and a zoom, can search automatically the changing point of the pan actuation made into the purpose, and zoom actuation, and enables efficient image edit.
[0007]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the camera work detection approach of this invention (1) The dynamic image which consists of a continuous image of two or more sheets

is inputted into time series per frame. By inter-frame [this] In the camera work detection approach of detecting a motion vector based on the correlation value over the amount of deviations of each representation point defined for every small block, and detecting a motion of a camera using this motion vector The motion vector detected at the representation point of the 1st frame of arbitration is used. The position vector of the representation point of the 2nd frame inputted just before this motion vector and the 1st frame is used. When it finds the integral until it exceeded the allowed value which asked for the 1st motion parameter which shows a motion of a camera, and asked for this 1st motion parameter for every frame, and was beforehand set to arbitration, and the integral value of the 1st motion parameter exceeds an allowed value The 2nd motion parameter which shows a motion of the camera of these limits of integration is computed by averaging this integral value by the limits of integration, and it is characterized by detecting a motion of a camera based on this 2nd motion parameter.

[0008] moreover, the camera work detection approach given in (2) above (1) -- setting -- the 2nd frame -- the pattern of an image -- un---- 1 -- a small block [like] being used as a standard dictionary, and near the small block in the 1st frame corresponding to this standard dictionary It asks for the pattern of this standard dictionary, and a pattern most in agreement, and is characterized by detecting the difference lost-motion vector of the location in the inside of the 1st [of the pattern for which it asked] frame, and the location in the 2nd frame of a standard dictionary.

[0009] Moreover, the difference of the location in the inside of the 1st [of the pattern for which (3) above (2) was asked in the camera work detection approach of a publication] frame, and the location of the standard dictionary in the 2nd frame is characterized by searching for the point of the location of the arbitration of the pattern of a standard dictionary as a representation point.

[0010] Moreover, it sets from (4) above (1) to the camera work detection approach given in either of (3). It asks for the statistical deflection of the direction of the motion vector of each representation point defined for every small block, and magnitude. Compute the average value of the motion vector which has the deflection in the tolerance beforehand set to arbitration, and it asks for the parameter which shows the motion concerning rotation of a camera among the 1st motion parameter using the average value of this motion vector. The motion vector which has the direction of [in the tolerance which the difference with the direction of the position vector of each representation point defined for every small block set to arbitration beforehand] is extracted. The inner product of this motion vector and position vector that were extracted is computed to each. Normalize the

value adding this inner product and the magnitude of a position vector in the magnitude of a position vector, and each is asked for an image pick-up scale factor. It asks for the statistical deflection of the image pick-up scale factor for which each was asked, the average of the image pick-up scale factor of the deflection in the tolerance beforehand set to arbitration is computed, and it is characterized by asking for the parameter which shows the motion concerning lens migration of a camera among the 1st motion parameter using the average of this image pick-up scale factor.

[0011] And it sets from (5) above (1) to the camera work detection approach given in either of (4). The 2nd [based on the 1st motion parameter which shows the motion concerning rotation of a camera] motion parameter, And it is characterized by describing on the table which divides the 2nd [based on the 1st motion parameter which shows the motion concerning lens migration of a camera] motion parameter per frame, respectively, and registers it, searching this table, and detecting a motion of a camera per frame.

[0012]

[Function] In this invention, in order to describe automatically the zoom of the camera showing change of camera work, and the information on a pan for every frame, parameter estimation (1st motion parameter) of rotation of a camera and parameter estimation (1st motion parameter) of the image pick-up scale factor by lens migration are performed. For example, the motion vector of the dynamic image for every block for which time series was inputted and asked per frame is used for the parameter estimation of rotation of a camera, and it is a deed. Moreover, parameter estimation of the image pick-up scale factor by lens migration of a camera is performed using this motion vector and the position vector of a representation point. Furthermore, it integrates with the presumed parameter for every frame, respectively, and this presumption and integral processing are repeated and are performed until it exceeds the allowed value with which it integrated and which was moved and the parameter set to arbitration beforehand. When you exceed an allowed value, an integral value is averaged by those limits of integration, and let this average value be a formal motion vector (2nd motion parameter) in those limits of integration. By this, even when camera work is the speed carried out slowly, a motion vector required for detection of camera work can be obtained.

[0013] moreover, the motion vector of a block unit used for presumption of the 1st motion parameter -- un---- 1 -- the thing of a block which has a pattern [like] is extracted and the block with which the possibility of incorrect detection becomes high is removed in advance. Furthermore, presumption of a motion parameter can ask for the statistical deflection about the direction and size of the motion vector in two or more blocks, and can be beforehand removed also about the motion vector outside the

tolerance which has shifted from the direction which should exist essentially by the quantization error or the noise.
[0014] Furthermore, for every frame, the reliable motion information on a pan or the camera of a zoom which carried out in this way and was acquired can be described automatically, and can be stored, respectively. And based on each stored information, the changing point of the pan actuation made into the purpose and zoom actuation is searched, and efficient image edit is attained.
[0015]
[Example] [0016] which explains the example of this invention to a detail with a drawing hereafter Drawing 1 is the whole camera work detection-system block diagram of the dynamic image in which one example of this invention is shown.
[0017] The camera work detection system of this example is videodisk equipment (among drawing) which records a video data sequentially. VD, publication 10, and a video tape recorder 11 (the inside of drawing, VTR, and publication), And the television tuner which receives the image transmitted to a target on the other hand from a broadcasting station etc. with constant speed (broadcast) (among drawing) The dynamic-image input/output equipment which consists of a TVT and publication 12, The program performed with the video controller 13 which performs control of such dynamic-image input/output equipment and a switch of an input place, the frame memory 14 in which a dynamic image is stored for every frame, the central processing unit 15 which performs control of the whole system, and a central processing unit 15, It is constituted by the magnetic disk drive 17 which is external memory for filling up the capacity of the main memory 16 which stores the data used, and main memory 16.
[0018] And the motion vector detection program 2 which detects the dynamic-image lost-motion vector stored in the frame memory 14 to main memory 16 (the detection Pgm among drawing, and publication), The motion electrical-parameter-extraction processing program 3 which performs extract processing of a motion parameter (namely, the 1st, 2 motion parameters) which shows a motion of a pan and a zoom from the detected motion vector (the extract Pgm among drawing, and publication), The registration processing program which registers into the motion description table 18 of main memory 16 the motion parameter which shows a motion of the pan and zoom which were extracted (among drawing) Camera work detection / registration processing program (the camera work processing Pgm among drawing and publication) 1 which consists of registration Pgm and publication 4 is stored. A central processing unit 15 Based on this camera work detection / registration processing program 1, the camera work detection and registration processing concerning this invention are

performed.
[0019] Although videodisk equipment 10 records a video data sequentially, random access is possible for it. Moreover, slow playback is possible, although a video tape recorder 11 records a video data sequentially and access is also a sequential access. And the television tuner 12 is unrecordable and, on the other hand, an image is transmitted to ** from a broadcasting station etc. with constant speed (broadcast).
[0020] An input place is switched to those one, and a video controller 13 connects with it, incorporates a dynamic image, and stores it temporarily one frame at a time at a frame memory 14 while it controls various kinds of dynamic-image input/output equipment, such as videodisk equipment 10, a video tape recorder 11, and the television tuner 12, based on the command of a central processing unit 15.
[0021] And based on camera work detection / registration processing program 1, a central processing unit 15 analyzes a motion of the dynamic image read from the frame memory 14, and describes the information on the camera work of the dynamic image which consists of the changing point, i.e., the pan, and zoom of the dynamic image in the scene between the analyzed middle data, for example, the change of a cut, on the motion description table 18 of main memory 16 for every frame. In addition, you may register with a magnetic disk drive 17, once moving also to a magnetic disk drive 17, forming the description table 18 and storing the information on camera work in main memory 16.
[0022] Thus, with the camera work detection system of this example, it becomes possible to support retrieval of a dynamic image, such as "me wanting to see the scene which is carrying out the pan to the left from the right", or "wanting to see the scene immediately after zoom-in", and the editing task of a dynamic image, such as "I want to correct the wow and flutter of a pan", and "wanting to make the rate of a pan quicker", for example by [which described the information on camera work] moving and using the description table 18. In addition, the amount of motion vectors which does not describe on the motion description table 18, for example, shows a pan and a zoom is specified beforehand, and actuation of detecting camera work is also possible, comparing the motion vector of the dynamic image inputted.
[0023] Thus, a special hardware configuration cannot be prepared but equipments, such as an AV equipment (voice visual equipment) and a workstation, can constitute it from the camera work detection system of this example easily. Hereafter, the processing actuation concerning this invention by the camera work detection system of this example is explained in detail.
[0024] Drawing 2 is a flow chart which shows the camera work detection processing actuation concerning this invention of the central processing unit

in drawing 1 .
[0025] Detection actuation of the motion parameter of camera work by the central processing unit 15 of drawing 1 and description actuation of the motion for every frame of the dynamic image by this detection are shown.
[0026] Initial value is given to various variables by initialization processing (box 60). Detail of initialization processing is given by drawing 6 . Next, in image input process (box 61), only one dynamic image (namely, the 1st frame) is incorporated to a frame memory 14. When the image at this time is set to Pn, in the frame memory 14, image Pn-1 of the frame in front of one (namely, the 2nd frame) is stored. And in motion vector detection processing (box 62), an image is divided into much blocks and a motion vector (namely, 1st motion parameter) is calculated for the block of every. Here, it asks for the motion vector of the point of the center position of a block. The detail of this motion vector detection processing is later mentioned by drawing 7 R> 7. Thus, the central processing unit 15 of drawing 1 performs the detection and registration processing to a motion of the pan concerning this invention, and a motion of a zoom based on camera work detection / registration processing program 1 of drawing 1 using the motion vector for which it asked for every block.
[0027] That is, the motion vector for which it asked for every block is statistically processed by motion detection processing (box 63) of a pan, and an unusual motion vector calculates the motion parameter of a pan, after excepting. This raises the dependability of the detected motion vector. In addition, detail of motion detection processing of a pan is given by drawing 8 . Next, integral processing (box 64) is integrated with the motion parameter of a pan for every frame. Thereby, a pan with a slow rate can also be correctly detected now. Detail of integral processing is given by drawing 9 . Furthermore, with the decision box 65, the time of the absolute value of an integral result exceeding the predetermined threshold alpha is detected. When it exceeds, the average in the limits of integration is calculated by the average processing (box 66) by the limits of integration by dividing an integral result by the frame number which carried out necessary by the limits of integration. And the motion parameter (namely, 2nd motion parameter) of the pan which becomes the motion description table 18 in the main memory 16 of drawing 1 from this average is written in by motion registration processing (box 67) of a pan. In addition, the various variables for the integral processing after registration termination are initialized. Moreover, drawing 10 and drawing 11 explain the detail of the average processing by these limits of integration, and motion registration processing of a pan, respectively.
[0028] Next, in scale-factor detection processing (box 68) of a zoom, after processing statistically the motion vector and position vector for which it asked for every block and excepting an unusual motion vector, the

scale-factor parameter of a zoom is calculated. Detail of motion detection processing of this zoom is given by drawing 12 . Furthermore, integral processing (box 69) is integrated with the scale-factor parameter of a zoom for every frame. Thereby, a zoom with a slow rate can also be correctly detected now. Detail of integral processing is given by drawing 13 . In addition, since a scale-factor parameter is set to "1" in the condition of having not carried out a zoom, an integral uses this for the next processing using the value of a scale-factor parameter "1." It asks for an average by the limits of integration, and when the time of the absolute value of an integral result exceeding the predetermined threshold beta is detected and it exceeds, drawing 1 moves by the decision box 70, and description table 18 HE registration of the scale-factor parameter of a zoom is carried out with it. That is, by dividing by the frame number which carried out necessary [of the integral result] by the limits of integration by the average processing (box 71) by the limits of integration, an average value is calculated and the scale-factor parameter of a zoom is written in the motion description table 18 in the main memory 16 of drawing 1 by scale-factor registration processing (box 72) of a zoom. In addition, the various variables for integral processing after registration termination are initialized. Moreover, detail of the average processing by these limits of integration and scale-factor registration processing of a zoom is given by drawing 14 and drawing 15 , respectively.
[0029] Thus, after the motion registration processing of a pan and the scale-factor registration processing of a zoom in one frame are completed, a frame update process (box 73) is performed, processing from a box 61 to a box 72 is repeated, and motion registration processing of a pan and scale-factor registration processing of a zoom are performed to the following frame. In addition, when the motion description table 18 of drawing 1 is stored in the main memory 16 of drawing 1 R> 1 and a frame number becomes large, you may make it store in the magnetic disk 17 of drawing 1 which is external memory.
[0030] Next, a pan and the motion detection approach of a zoom are explained.
[0031] Drawing 3 is the explanatory view showing one example of the transparent transformation model of the camera work detected with the camera work detection system in drawing 1 .
[0032] In drawing 3 , signs 20, 21, and 22 are the shafts of the rectangular coordinate system of space, and are the X-axis 20, Y-axis 21, and the Z-axis 22, respectively. Moreover, a sign 23 is an image side, and the Z-axis 22 pierces through the image zero o of this image side 23, and it is taken as a flat surface which becomes perpendicular. f is the distance of the zero O of a rectangular coordinate system, and the image side 23, and calls it a focal

distance. Moreover, Zero O is called a view. In this transparent transformation model, the point P in space (X, Y, Z) is projected on the intersection p with the image side 23 of the straight line which connects this Point P and Zero O. If the image coordinate of the point p is set to (x, y), it will be from the geometric relation of a transparent transformation model.
x=(fxX) /Z y=(fxY) /Z (several 1)
It becomes. According to this model, the camera work called a pan is movement which rotates the X-axis 20 or Y-axis 21, and the camera work called a zoom is movement of the parallel displacement of the Z-axis 22 of the image side 23. First, explanation about a motion of a pan, for example, movement which rotates Y-axis 21, is performed.
[0033] Drawing 4 is the explanatory view showing one example of motion detection actuation of the pan of the camera work detection system in drawing 1 .
[0034] The example of the motion vector on the image side 23 by rotation of the image side 23 of the circumference of Y-axis 21 shown by drawing 3 and drawing 4 (b) is shown, and the motion vector (arrow head in drawing) of each block 30 turns to the direction where the thing of the almost same magnitude is the same in drawing 4 (a). Drawing 4 (b) shows motion vector v (vx, vy) of the point p (x y) when system of coordinates rotate only deltatheta to the circumference of Y-axis 21.
[0035] Here, the motion vector component vx of X shaft orientations of Point p is drawing 4 (b). vx=fx (tan(theta+deltatheta)-tantheta) (several 2)
It becomes. Here, theta is an include angle with YZ flat surface of the position vector from the zero O of Point p to make, and is tan theta=x/f. Then, when several 2 is transformed, it is. vx=fx (tan theta+tandeltatheta) (/(1-tan thetaxtandeltatheta)-tantheta) (several 3)
It becomes. Here, for a focal distance f, when sufficiently larger than the size of the image side 23, several 3 . Vx**fxtandeltatheta (several 4)
It can come out and approximate. Therefore, the rotational speed of a camera is indirectly called for by asking for motion vector v.
[0036] Next, explanation about a motion of a zoom, i.e., movement of the parallel displacement of the Z-axis 22 of the image side 23, is performed.
[0037] Drawing 5 is the explanatory view showing one example of motion detection actuation of the zoom of the camera work detection system in drawing 1 .
[0038] In drawing 3 , the example of the motion vector on the image side 23 by parallel translation deltaf of the image side 23 from Zero O to Z-axis 22 direction is shown, and the motion vector of each block 30 becomes large in proportion to the distance from the image zero o in the direction of the image zero o to a radial. Here, it is the scale factor z of a zoom. z=(f+deltaf) /f (several 5)

Come out, it is and the absolute value is used with the transparent transformation model of drawing 3 from the position vector pv1 (x1, y1) of the point p on the image side at the time of a focal distance f, and the position vector pv2 (x2, y2) of the point p at the time of focal distance f+delta f. z=||pv2||/||pv1|| (several 6)
But it can describe. Motion vector v of the point p on an image side is further used for several 6. z=||pv1+v||/||pv1|| (several 7)
It can come out and describe. Moreover, since motion vector v may have an error in a noise etc., he is trying for a position vector pv1 and a direction to add only the magnitude of the same component in this example. namely, -- z=(||pv1||) (+ (v-pv1)) /||pv1|| (several 8)
It comes out and asks for a zoom scale factor.
[0039] Next, the detail of each processing box of the camera work detection system in drawing 1 explained by drawing 2 is explained.
[0040] Drawing 6 is a flow chart which shows one example of the detail of the initialization processing in drawing 2 .
[0041] With a box 601, the initial value of various variables is reset to 0. That is, the variables PS and PE meaning the frame number of the variables SGMVX and SGMVY meaning the work area for the integral of the motion parameter of a pan and the variable SGMZ meaning the work area for the integral of a zoom scale factor, the variable n meaning a frame number, the starting point of the limits of integration of the motion parameter of a pan, and a terminal point and the variables ZS and ZE meaning the frame number of the starting point of the limits of integration of the motion parameter of a zoom scale factor and a terminal point are altogether set to "0."
[0042] Drawing 7 is a flow chart which shows one example of the detail of the motion vector detection processing in drawing 2 .
[0043] First, the motion vector detection flag Fk is reset to 0 with a box 621. This is in the condition that detection of the motion vector in Block k was not carried out. Next, with a box 622, it judges whether Block k is suitable for motion vector detection. That is, by the pattern of concentration with the uniform inside of a block, since the correlation value by pattern matching is used for motion vector detection in this invention, even if a correlation value is low, it will be unreliable. Then, it is confirmed in advance whether length, width, and a slanting pattern component are contained more than constant value in the block.
[0044] In block 623, length, width, and a slanting pattern component are contained more than constant value in a block, and it is confirmed whether a pattern is un-uniform. And if it judges with a pattern being un-uniform, block 624 will detect the motion vector by pattern matching. Namely, in block 624, the correlation value Min which serves as min in Image Pn, and the deviations delta Xk and delta Yk at that time are searched for by using the

pattern of the block k of image Pn−1 one frame ago as a standard dictionary. And in block 625, the correlation value used as min judges that it is smaller than a threshold gamma. If small, with a box 626, the motion vector detection flag Fk will be set to 1, and it will change into the condition that the motion vector was able to be found with Block k.

[0045] When the above thing is performed about all blocks k, many motion vectors will be obtained with each block of a screen. Thus, in this example, since the pattern within a block is checked before asking for a motion vector, a reliable motion vector can be found. Moreover, since it is motion detection by pattern matching, it operates to stability also to a noise.

[0046] Drawing 8 is a flow chart which shows one example of the detail of motion detection processing of the pan in drawing 2 .

[0047] First, in block 631, the average (AVEVX, AVEVY) of the motion vector for which it asked with each block, and standard deviation (STVX, STVY) are calculated. Next, it asks for the motion vector which is contained in the standard deviation from this average with block 632 from the motion vector called for with each block. And in block 633, about the motion vector which is contained in the standard deviation from the average, it asks for an average and considers as the motion vector (VX, VY) of a pan. Thus, in this example, it is equalizing, after removing not a simple average but an unusual motion vector, and the dependability of the motion vector obtained becomes high. Moreover, even if a migration body appears all over a screen, if it is below one half of a full screen, the effect will not exist.

[0048] Drawing 9 is a flow chart which shows one example of the detail of motion integral processing of the pan in drawing 2 .

[0049] With block 641, an integral result is stored in SGMVX and SGMVY, and by block 642, one frame of the terminal point of the limits of integration is updated, and it stores in Variable PE.

[0050] Drawing 10 is a flow chart which shows one example of the detail of the average processing by the limits of integration of the pan in drawing 2 .

[0051] In block 661, it is the limits of integration (PE−PS), and SGMVX and SGMVY are broken and the motion parameter of a pan is stored in Variables DX and DY.

[0052] Drawing 11 is a flow chart which shows one example of the detail of motion registration processing of the pan in drawing 2 .

[0053] Variables DX and DY are registered into the term of DX and DY to which it corresponds from the frame section PS in the motion description table 18 of drawing 1 R> 1 to PE−1 with block 671. Next, the contents of the variable PE are substituted for Variable PS with block 672 for initialization of the following limits of integration. And Variables SGMVX and SGMVY are reset to 0 with block 673 for initialization of the following integral.

[0054] Drawing 12 is a flow chart which shows one example of the detail of

scale-factor detection processing of a zoom in drawing 2 .

[0055] In block 681, the scale factor Zk of a zoom is calculated with a formula 8 from the position vector of the point of the core of each block, and the motion vector corresponding to it. In addition, when the direction of a motion vector and the direction of a position vector are sharply shifted at this time, it is judged as an unusual motion vector and scale-factor count of a zoom is not performed. Moreover, focusing on a value 1, the scale factor Zk of a zoom becomes larger than 1 at the time of zoom-in, and becomes small from 1 at the time of a zoom down. Next, in block 682, the average and standard deviation of the zoom scale factor Zk for which it asked with each block are calculated, and it stores in Variables AVEZ and STVZ, respectively. And with block 683, the zoom scale factor Zk for which it asked with each block asks for an average only about what is contained in standard deviation from this average, and considers as the zoom scale factor Z. Thus, in this example, it is equalizing, after removing not a simple average but an unusual zoom scale factor also about detection of a zoom, and the dependability of the zoom scale factor obtained becomes high. Moreover, like the case of detection of a pan, even if a migration body appears all over a screen, if it is below one half of a full screen, the effect will not exist.

[0056] Drawing 13 is a flow chart which shows one example of the detail of scale-factor integral processing of a zoom in drawing 2 .

[0057] Although an integral result is stored in Variable SGMZ with block 691, it integrates with what deducted 1 from the zoom scale factor Z in this case. Next, with block 692, one frame of the terminal point of the limits of integration is updated, and it stores in Variable ZE.

[0058] Drawing 14 is a flow chart which shows one example of the detail of the average processing by the limits of integration of a zoom in drawing 2 .

[0059] In block 711, after breaking SGMZ by the limits of integration (ZE−ZS) and adding 1 to it, the scale factor of a zoom is stored in Variable Z.

[0060] Drawing 15 is a flow chart which shows one example of the detail of scale-factor registration processing of a zoom in drawing 2 .

[0061] Variable Z is registered into the term of Z to which it corresponds from the frame section ZS in the motion description table 18 of drawing 1 to ZE−1 in block 721. Next, the contents of the variable ZE are substituted for Variable ZS with block 722 for initialization of the following limits of integration. Moreover, Variable SGMZ is reset to 0 with block 723 for initialization of the following integral.

[0062] As mentioned above, as explained using drawing 1 − drawing 15 , according to the camera work detection approach of this example, camera works, such as a pan and a zoom, can be automatically described for every frame. Since much blocks have detected the motion vector at this time, it can become possible to remove beforehand the motion vector which has

TECHNICAL FIELD

[Industrial Application] This invention searches the dynamic-image frame which makes into the purpose from the dynamic image especially stored in the video tape or the videodisk based on motion (right-and-left [of a camera] , and rotation [vertically]) information , such as a zoom (change of the image pick-up scale factor by migration of the lens of a camera) of a camera , and a pan , a tilt , with respect to the description approach of the scene of the dynamic image which is needed at the time of image edit of video or a movie , and relates to the suitable camera work detection approach to perform image edit efficiently .

[Translation done.]

conflict statistically, and the dependability of the contents of description can be raised. Moreover, a motion parameter can perform detection of a motion parameter, even when it is the speed which he is trying to integrate with for every frame, and camera work carried out slowly. Moreover, in order to accelerate processing, an image may be thinned out in about 1/8 size for example, at the image input-process time. In this case, it will thin out, if detection precision becomes coarse and there is no motion of 8 pixels or more inter-frame, and it cannot detect on an image. However, a motion is detectable, while trying to find the integral for every frame and integrating with eight frames. Therefore, the usual workstation can also describe the camera work of a dynamic image at a practical rate.
[0063]
[Effect of the Invention] According to this invention, it is correctly detectable, and even if a migration body trespasses upon a screen, it becomes possible to detect and describe at a high speed also by usual workstation, and camera works, such as a pan and a zoom, can be effectively used as information on speed-regulation activities by the descriptive data of this camera work, such as retrieval of the dynamic image at the time of video edit, and a pan, and improvement in image edit processing actuation is attained.
[0064]

[Translation done.]

video camera only from the motion vector by vibration.

[Translation done.]

PRIOR ART

[Description of the Prior Art] By detecting the changing point of an image automatically from the dynamic image stored in the video tape etc. conventionally, the change of a scene is detected and the technique which makes easy head broth actuation at the time of dynamic-image edit etc. is indicated by Japanese Patent Application No. 2-230930. By using the information about camera works, such as a motion of the video camera itself, i.e., the zoom of a video camera, and a pan, further for every scene detected using this technique For example, "I want to see the scene which is carrying out the pan to the left from the right." Or it enables an edit system to support retrieval of a dynamic image, such as "wanting to see the scene immediately after zoom-in", and the editing task of a dynamic image, such as "I want to correct the wow and flutter of a pan", and "wanting to make the rate of a pan quicker." For that purpose, camera works, such as a zoom of a video camera and a pan, are detected, and the technique which describes it automatically is needed.

[0003] Conventionally, as a technique of detecting a motion of the video camera itself, the thing of a publication is in JP,2-157980,A, for example. This detects vibration of a video camera and amends image Bure. That is, on a screen, about four comparatively big detection fields are set up, for example, with the correlation value in a predetermined deviation, it asks for an inter-frame motion vector, and the motion vector of a screen is determined from the judgment result of the condition of a correlation value, and the dependability of the motion vector before it. When the motion vector by vibration of a video camera vibrates focusing on zero vector and a migration object invades, a motion of a migration object and a motion of a video camera are added, and a motion vector can be found. The motion vector at this time becomes that by which constant value was added to the motion vector by vibration, and separation with the motion vector by vibration is possible for it, and it amends Bure of the image by vibration of a

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In a Prior art, since the trouble which it is going to solve cannot detect correctly the motion vector which shows the motion which the camera itself carried out slowly, it is a point which cannot detect camera works, such as a pan and a zoom, automatically and cannot perform efficient image edit.
[0005] Namely, oscillating detection of a video camera is the purpose and, as for equipment given in JP,2-157980,A, consideration is not paid to the detection purpose of camera works, such as a pan and a zoom. For example, it judges with that from which the migration object trespassed upon the left with above-mentioned equipment about the image which carried out the pan of the video camera from the right, and is not regarded as a motion of a camera. Moreover, although a motion vector is detected in the direction of a radial from the bottom of its heart among a screen about the image at the time of zoom-in or a zoom down, there is no means to change into the scale-factor value of a zoom from those motion vectors. A motion of a pan and the video camera at the time of a zoom has a rate still slower than a motion of a hand deflection. Therefore, possibility that precision sufficient with the above-mentioned equipment which determines a motion of a screen by one motion detection will not be acquired is high.
[0006] The purpose of this invention is offering the camera work detection approach which solves such a conventional technical problem, detects a motion of a camera from images, such as a pan with a slow rate, and a zoom, can search automatically the changing point of the pan actuation made into the purpose, and zoom actuation, and enables efficient image edit.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, it is correctly detectable, and even if a migration body trespasses upon a screen, it becomes possible to detect and describe at a high speed also by usual workstation, and camera works, such as a pan and a zoom, can be effectively used as information on speed-regulation activities by the descriptive data of this camera work, such as retrieval of the dynamic image at the time of video edit, and a pan, and improvement in image edit processing actuation is attained.

[Translation done.]

approach of a publication] frame, and the location of the standard dictionary in the 2nd frame is characterized by searching for the point of the location of the arbitration of the pattern of a standard dictionary as a representation point.

[0010] Moreover, it sets from (4) above (1) to the camera work detection approach given in either of (3). It asks for the statistical deflection of the direction of the motion vector of each representation point defined for every small block, and magnitude. Compute the average value of the motion vector which has the deflection in the tolerance beforehand set to arbitration, and it asks for the parameter which shows the motion concerning rotation of a camera among the 1st motion parameter using the average value of this motion vector. The motion vector which has the direction of [in the tolerance which the difference with the direction of the position vector of each representation point defined for every small block set to arbitration beforehand] is extracted. The inner product of this motion vector and position vector that were extracted is computed to each. Normalize the value adding this inner product and the magnitude of a position vector in the magnitude of a position vector, and each is asked for an image pick-up scale factor. It asks for the statistical deflection of the image pick-up scale factor for which each was asked, the average of the image pick-up scale factor of the deflection in the tolerance beforehand set to arbitration is computed, and it is characterized by asking for the parameter which shows the motion concerning lens migration of a camera among the 1st motion parameter using the average of this image pick-up scale factor.

[0011] And it sets from (5) above (1) to the camera work detection approach given in either of (4). The 2nd [based on the 1st motion parameter which shows the motion concerning rotation of a camera] motion parameter, And it is characterized by describing on the table which divides the 2nd [based on the 1st motion parameter which shows the motion concerning lens migration of a camera] motion parameter per frame, respectively, and registers it, searching this table, and detecting a motion of a camera per frame.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the camera work detection approach of this invention (1) The dynamic image which consists of a continuous image of two or more sheets is inputted into time series per frame. By inter-frame [this] In the camera work detection approach of detecting a motion vector based on the correlation value over the amount of deviations of each representation point defined for every small block, and detecting a motion of a camera using this motion vector The motion vector detected at the representation point of the 1st frame of arbitration is used. The position vector of the representation point of the 2nd frame inputted just before this motion vector and the 1st frame is used. When it finds the integral until it exceeded the allowed value which asked for the 1st motion parameter which shows a motion of a camera, and asked for this 1st motion parameter for every frame, and was beforehand set to arbitration, and the integral value of the 1st motion parameter exceeds an allowed value The 2nd motion parameter which shows a motion of the camera of these limits of integration is computed by averaging this integral value by the limits of integration, and it is characterized by detecting a motion of a camera based on this 2nd motion parameter.

[0008] moreover, the camera work detection approach given in (2) above (1) -- setting -- the 2nd frame -- the pattern of an image -- un-- 1 -- a small block [like] being used as a standard dictionary, and near the small block in the 1st frame corresponding to this standard dictionary It asks for the pattern of this standard dictionary, and a pattern most in agreement, and is characterized by detecting the difference lost-motion vector of the location in the inside of the 1st [of the pattern for which it asked] frame, and the location in the 2nd frame of a standard dictionary.

[0009] Moreover, the difference of the location in the inside of the 1st [of the pattern for which (3) above (2) was asked in the camera work detection

or the camera of a zoom which carried out in this way and was acquired can be described automatically, and can be stored, respectively. And based on each stored information, the changing point of the pan actuation made into the purpose and zoom actuation is searched, and efficient image edit is attained.

[Translation done.]

OPERATION

[Function] In this invention, in order to describe automatically the zoom of the camera showing change of camera work, and the information on a pan for every frame, parameter estimation (1st motion parameter) of rotation of a camera and parameter estimation (1st motion parameter) of the image pick-up scale factor by lens migration are performed. For example, the motion vector of the dynamic image for every block for which time series was inputted and asked per frame is used for the parameter estimation of rotation of a camera, and it is a deed. Moreover, parameter estimation of the image pick-up scale factor by lens migration of a camera is performed using this motion vector and the position vector of a representation point. Furthermore, it integrates with the presumed parameter for every frame, respectively, and this presumption and integral processing are repeated and are performed until it exceeds the allowed value with which it integrated and which was moved and the parameter set to arbitration beforehand. When you exceed an allowed value, an integral value is averaged by those limits of integration, and let this average value be a formal motion vector (2nd motion parameter) in those limits of integration. By this, even when camera work is the speed carried out slowly, a motion vector required for detection of camera work can be obtained.
[0013] moreover, the motion vector of a block unit used for presumption of the 1st motion parameter -- un-- 1 -- the thing of a block which has a pattern [like] is extracted and the block with which the possibility of incorrect detection becomes high is removed in advance. Furthermore, presumption of a motion parameter can ask for the statistical deflection about the direction and size of the motion vector in two or more blocks, and can be beforehand removed also about the motion vector outside the tolerance which has shifted from the direction which should exist essentially by the quantization error or the noise.
[0014] Furthermore, for every frame, the reliable motion information on a pan

Pgm among drawing and publication) 1 which consists of registration Pgm and publication 4 is stored. A central processing unit 15 Based on this camera work detection / registration processing program 1, the camera work detection and registration processing concerning this invention are performed.
[0019] Although videodisk equipment 10 records a video data sequentially, random access is possible for it. Moreover, slow playback is possible, although a video tape recorder 11 records a video data sequentially and access is also a sequential access. And the television tuner 12 is unrecordable and, on the other hand, an image is transmitted to ** from a broadcasting station etc. with constant speed (broadcast).
[0020] An input place is switched to those one, and a video controller 13 connects with it, incorporates a dynamic image, and stores it temporarily one frame at a time at a frame memory 14 while it controls various kinds of dynamic-image input/output equipment, such as videodisk equipment 10, a video tape recorder 11, and the television tuner 12, based on the command of a central processing unit 15.
[0021] And based on camera work detection / registration processing program 1, a central processing unit 15 analyzes a motion of the dynamic image read from the frame memory 14, and describes the information on the camera work of the dynamic image which consists of the changing point, i.e., the pan, and zoom of the dynamic image in the scene between the analyzed middle data, for example, the change of a cut, on the motion description table 18 of main memory 16 for every frame. In addition, you may register with a magnetic disk drive 17, once moving also to a magnetic disk drive 17, forming the description table 18 and storing the information on camera work in main memory 16.
[0022] Thus, with the camera work detection system of this example, it becomes possible to support retrieval of a dynamic image, such as "me wanting to see the scene which is carrying out the pan to the left from the right", or "wanting to see the scene immediately after zoom-in", and the editing task of a dynamic image, such as "I want to correct the wow and flutter of a pan", and "wanting to make the rate of a pan quicker", for example by [which described the information on camera work] moving and using the description table 18. In addition, the amount of motion vectors which does not describe on the motion description table 18, for example, shows a pan and a zoom is specified beforehand, and actuation of detecting camera work is also possible, comparing the motion vector of the dynamic image inputted.
[0023] Thus, a special hardware configuration cannot be prepared but equipments, such as an AV equipment (voice visual equipment) and a workstation, can constitute it from the camera work detection system of this

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EXAMPLE

[Example] [0016] which explains the example of this invention to a detail wi a drawing hereafter Drawing 1 is the whole camera work detection-system block diagram of the dynamic image in which one example of this invention is shown.
[0017] The camera work detection system of this example is videodisk equipment (among drawing) which records a video data sequentially. VD, publication 10, and a video tape recorder 11 (the inside of drawing, VTR, and publication), And the television tuner which receives the image transmitted to a target on the other hand from a broadcasting station etc. with constant speed (broadcast) (among drawing) The dynamic-image input/output equipment which consists of a TVT and publication 12, The program performed with the video controller 13 which performs control of such dynamic-image input/output equipment and a switch of an input place, the frame memory 14 in which a dynamic image is stored for every frame, the central processing unit 15 which performs control of the whole system, and a central processing unit 15, It is constituted by the magnetic disk drive 17 which is external memory for filling up the capacity of the main memory 16 which stores the data used, and main memory 16.
[0018] And the motion vector detection program 2 which detects the dynamic-image lost-motion vector stored in the frame memory 14 to main memory 16 (the detection Pgm among drawing, and publication), The motion electrical-parameter-extraction processing program 3 which performs extract processing of a motion parameter (namely, the 1st, 2 motion parameters) which shows a motion of a pan and a zoom from the detected motion vector (the extract Pgm among drawing, and publication), The registration processing program which registers into the motion description table 18 of main memory 16 the motion parameter which shows a motion of the pan and zoom which were extracted (among drawing) Camera work detection / registration processing program (the camera work processing

example easily. Hereafter, the processing actuation concerning this invention by the camera work detection system of this example is explained in detail.
[0024] Drawing 2 is a flow chart which shows the camera work detection processing actuation concerning this invention of the central processing unit in drawing 1 .
[0025] Detection actuation of the motion parameter of camera work by the central processing unit 15 of drawing 1 and description actuation of the motion for every frame of the dynamic image by this detection are shown.
[0026] Initial value is given to various variables by initialization processing (box 60). Detail of initialization processing is given by drawing 6 . Next, in image input process (box 61), only one dynamic image.(namely, the 1st frame) is incorporated to a frame memory 14. When the image at this time is set to Pn, in the frame memory 14, image Pn-1 of the frame in front of one (namely, the 2nd frame) is stored. And in motion vector detection processing (box 62), an image is divided into much blocks and a motion vector (namely, 1st motion parameter) is calculated for the block of every. Here, it asks for the motion vector of the point of the center position of a block. The detail of this motion vector detection processing is later mentioned by drawing 7 R> 7. Thus, the central processing unit 15 of drawing 1 performs the detection and registration processing to a motion of the pan concerning this invention, and a motion of a zoom based on camera work detection / registration processing program 1 of drawing 1 using the motion vector for which it asked for every block.
[0027] That is, the motion vector for which it asked for every block is statistically processed by motion detection processing (box 63) of a pan, and an unusual motion vector calculates the motion parameter of a pan, after excepting. This raises the dependability of the detected motion vector. In addition, detail of motion detection processing of a pan is given by drawing 8 . Next, integral processing (box 64) is integrated with the motion parameter of a pan for every frame. Thereby, a pan with a slow rate can also be correctly detected now. Detail of integral processing is given by drawing 9 . Furthermore, with the decision box 65, the time of the absolute value of an integral result exceeding the predetermined threshold alpha is detected. When it exceeds, the average in the limits of integration is calculated by the average processing (box 66) by the limits of integration by dividing an integral result by the frame number which carried out necessary by the limits of integration. And the motion parameter (namely, 2nd motion parameter) of the pan which becomes the motion description table 18 in the main memory 16 of drawing 1 from this average is written in by motion registration processing (box 67) of a pan. In addition, the various variables for the integral processing after registration termination are initialized. Moreover, drawing 10 and drawing 11 explain the detail of the average processing by these limits of

integration, and motion registration processing of a pan, respectively.
[0028] Next, in scale-factor detection processing (box 68) of a zoom, after processing statistically the motion vector and position vector for which it asked for every block and excepting an unusual motion vector, the scale-factor parameter of a zoom is calculated. Detail of motion detection processing of this zoom is given by drawing 12 . Furthermore, integral processing (box 69) is integrated with the scale-factor parameter of a zoom for every frame. Thereby, a zoom with a slow rate can also be correctly detected now. Detail of integral processing is given by drawing 13 . In addition, since a scale-factor parameter is set to "1" in the condition of having not carried out a zoom, an integral uses this for the next processing using the value of a scale-factor parameter "1." It asks for an average by the limits of integration, and when the time of the absolute value of an integral result exceeding the predetermined threshold beta is detected and it exceeds, drawing 1 moves by the decision box 70, and description table 18 HE registration of the scale-factor parameter of a zoom is carried out with it. That is, by dividing by the frame number which carried out necessary [of the integral result] by the limits of integration by the average processing (box 71) by the limits of integration, an average value is calculated and the scale-factor parameter of a zoom is written in the motion description table 18 in the main memory 16 of drawing 1 by scale-factor registration processing (box 72) of a zoom. In addition, the various variables for integral processing after registration termination are initialized. Moreover, detail of the average processing by these limits of integration and scale-factor registration processing of a zoom is given by drawing 14 and drawing 15 , respectively.
[0029] Thus, after the motion registration processing of a pan and the scale-factor registration processing of a zoom in one frame are completed, a frame update process (box 73) is performed, processing from a box 61 to a box 72 is repeated, and motion registration processing of a pan and scale-factor registration processing of a zoom are performed to the following frame. In addition, when the motion description table 18 of drawing 1 is stored in the main memory 16 of drawing 1 R> 1 and a frame number becomes large, you may make it store in the magnetic disk 17 of drawing 1 which is external memory.
[0030] Next, a pan and the motion detection approach of a zoom are explained.
[0031] Drawing 3 is the explanatory view showing one example of the transparent transformation model of the camera work detected with the camera work detection system in drawing 1 .
[0032] In drawing 3 , signs 20, 21, and 22 are the shafts of the rectangular coordinate system of space, and are the X-axis 20, Y-axis 21, and the Z-axis

direction is shown, and the motion vector of each block 30 becomes large in proportion to the distance from the image zero o in the direction of the image zero o to a radial. Here, it is the scale factor z of a zoom. z=(f+deltaf) /f (several 5)
Come out, it is and the absolute value is used with the transparent transformation model of drawing 3 from the position vector pv1 (x1, y1) of the point p on the image side at the time of a focal distance f, and the position vector pv2 (x2, y2) of the point p at the time of focal distance f+delta f. z=||pv2||/||pv1|| (several 6)
But it can describe. Motion vector v of the point p on an image side is further used for several 6. z=||pv1+v||/||pv1|| (several 7)
It can come out and describe. Moreover, since motion vector v may have an error in a noise etc., he is trying for a position vector pv1 and a direction to add only the magnitude of the same component in this example. namely, -- z=(||pv1||) (+ (v-pv1)) /||pv1|| (several 8)
It comes out and asks for a zoom scale factor.
[0039] Next, the detail of each processing box of the camera work detection system in drawing 1 explained by drawing 2 is explained.
[0040] Drawing 6 is a flow chart which shows one example of the detail of the initialization processing in drawing 2 .
[0041] With a box 601, the initial value of various variables is reset to 0. That is, the variables PS and PE meaning the frame number of the variables SGMVX and SGMVY meaning the work area for the integral of the motion parameter of a pan and the variable SGMZ meaning the work area for the integral of a zoom scale factor, the variable n meaning a frame number, the starting point of the limits of integration of the motion parameter of a pan, and a terminal point and the variables ZS and ZE meaning the frame number of the starting point of the limits of integration of the motion parameter of a zoom scale factor and a terminal point are altogether set to "0."
[0042] Drawing 7 is a flow chart which shows one example of the detail of the motion vector detection processing in drawing 2 .
[0043] First, the motion vector detection flag Fk is reset to 0 with a box 621. This is in the condition that detection of the motion vector in Block k was not carried out. Next, with a box 622, it judges whether Block k is suitable for motion vector detection. That is, by the pattern of concentration with the uniform inside of a block, since the correlation value by pattern matching is used for motion vector detection in this invention, even if a correlation value is low, it will be unreliable. Then, it is confirmed in advance whether length, width, and a slanting pattern component are contained more than constant value in the block.
[0044] In block 623, length, width, and a slanting pattern component are contained more than constant value in a block, and it is confirmed whether a

22, respectively. Moreover, a sign 23 is an image side, and the Z-axis 22 pierces through the image zero o of this image side 23, and it is taken as a flat surface which becomes perpendicular. f is the distance of the zero O of a rectangular coordinate system, and the image side 23, and calls it a focal distance. Moreover, Zero O is called a view. In this transparent transformation model, the point P in space (X, Y, Z) is projected on the intersection p with the image side 23 of the straight line which connects this Point P and Zero O. If the image coordinate of the point p is set to (x, y), it will be from the geometric relation of a transparent transformation model. x=(fxX) /Z y=(fxY) /Z (several 1)
It becomes. According to this model, the camera work called a pan is movement which rotates the X-axis 20 or Y-axis 21, and the camera work called a zoom is movement of the parallel displacement of the Z-axis 22 of the image side 23. First, explanation about a motion of a pan, for example, movement which rotates Y-axis 21, is performed.
[0033] Drawing 4 is the explanatory view showing one example of motion detection actuation of the pan of the camera work detection system in drawing 1 .
[0034] The example of the motion vector on the image side 23 by rotation of the image side 23 of the circumference of Y-axis 21 shown by drawing 3 and drawing 4 (b) is shown, and the motion vector (arrow head in drawing) of each block 30 turns to the direction where the thing of the almost same magnitude is the same in drawing 4 (a). Drawing 4 (b) shows motion vector v (vx, vy) of the point p (x y) when system of coordinates rotate only deltatheta to the circumference of Y-axis 21.
[0035] Here, the motion vector component vx of X shaft orientations of Point p is drawing 4 (b). vx=fx (tan(theta+deltatheta)-tantheta) (several 2)
It becomes. Here, theta is an include angle with YZ flat surface of the position vector from the zero O of Point p to make, and is tan theta=x/f. Then, when several 2 is transformed, it is. vx=fx (tan theta+tandeltatheta) (/(1-tan thetaxtandeltatheta)-tantheta) (several 3)
It becomes. Here, for a focal distance f, when sufficiently larger than the size of the image side 23, several 3 . Vx**fxtandeltatheta (several 4)
It can come out and approximate. Therefore, the rotational speed of a camera is indirectly called for by asking for motion vector v.
[0036] Next, explanation about a motion of a zoom, i.e., movement of the parallel displacement of the Z-axis 22 of the image side 23, is performed.
[0037] Drawing 5 is the explanatory view showing one example of motion detection actuation of the zoom of the camera work detection system in drawing 1 .
[0038] In drawing 3 , the example of the motion vector on the image side 23 by parallel translation deltaf of the image side 23 from Zero O to Z-axis 22

pattern is un-uniform. And if it judges with a pattern being un-uniform, block 624 will detect the motion vector by pattern matching. Namely, in block 624, the correlation value Min which serves as min in Image Pn, and the deviations delta Xk and delta Yk at that time are searched for by using the pattern of the block k of image Pn-1 one frame ago as a standard dictionary. And in block 625, the correlation value used as min judges that it is smaller than a threshold gamma. If small, with a box 626, the motion vector detection flag Fk will be set to 1, and it will change into the condition that the motion vector was able to be found with Block k.

[0045] When the above thing is performed about all blocks k, many motion vectors will be obtained with each block of a screen. Thus, in this example, since the pattern within a block is checked before asking for a motion vector, a reliable motion vector can be found. Moreover, since it is motion detection by pattern matching, it operates to stability also to a noise.

[0046] Drawing 8 is a flow chart which shows one example of the detail of motion detection processing of the pan in drawing 2 .

[0047] First, in block 631, the average (AVEVX, AVEVY) of the motion vector for which it asked with each block, and standard deviation (STVX, STVY) are calculated. Next, it asks for the motion vector which is contained in the standard deviation from this average with block 632 from the motion vector called for with each block. And in block 633, about the motion vector which is contained in the standard deviation from the average, it asks for an average and considers as the motion vector (VX, VY) of a pan. Thus, in this example, it is equalizing, after removing not a simple average but an unusual motion vector, and the dependability of the motion vector obtained becomes high. Moreover, even if a migration body appears all over a screen, if it is below one half of a full screen, the effect will not exist.

[0048] Drawing 9 is a flow chart which shows one example of the detail of motion integral processing of the pan in drawing 2 .

[0049] With block 641, an integral result is stored in SGMVX and SGMVY, and by block 642, one frame of the terminal point of the limits of integration is updated, and it stores in Variable PE.

[0050] Drawing 10 is a flow chart which shows one example of the detail of the average processing by the limits of integration of the pan in drawing 2 .

[0051] In block 661, it is the limits of integration (PE-PS), and SGMVX and SGMVY are broken and the motion parameter of a pan is stored in Variables DX and DY.

[0052] Drawing 11 is a flow chart which shows one example of the detail of motion registration processing of the pan in drawing 2 .

[0053] Variables DX and DY are registered into the term of DX and DY to which it corresponds from the frame section PS in the motion description table 18 of drawing 1 R> 1 to PE-1 with block 671. Next, the contents of the

variable PE are substituted for Variable PS with block 672 for initialization of the following limits of integration. And Variables SGMVX and SGMVY are reset to 0 with block 673 for initialization of the following integral.

[0054] Drawing 12 is a flow chart which shows one example of the detail of scale-factor detection processing of a zoom in drawing 2 .

[0055] In block 681, the scale factor Zk of a zoom is calculated with a formula 8 from the position vector of the point of the core of each block, and the motion vector corresponding to it. In addition, when the direction of a motion vector and the direction of a position vector are sharply shifted at this time, it is judged as an unusual motion vector and scale-factor count of a zoom is not performed. Moreover, focusing on a value 1, the scale factor Zk of a zoom becomes larger than 1 at the time of zoom-in, and becomes small from 1 at the time of a zoom down. Next, in block 682, the average and standard deviation of the zoom scale factor Zk for which it asked with each block are calculated, and it stores in Variables AVEZ and STVZ, respectively. And with block 683, the zoom scale factor Zk for which it asked with each block asks for an average only about what is contained in standard deviation from this average, and considers as the zoom scale factor Z. Thus, in this example, it is equalizing, after removing not a simple average but an unusual zoom scale factor also about detection of a zoom, and the dependability of the zoom scale factor obtained becomes high. Moreover, like the case of detection of a pan, even if a migration body appears all over a screen, if it is below one half of a full screen, the effect will not exist.

[0056] Drawing 13 is a flow chart which shows one example of the detail of scale-factor integral processing of a zoom in drawing 2 .

[0057] Although an integral result is stored in Variable SGMZ with block 691, it integrates with what deducted 1 from the zoom scale factor Z in this case. Next, with block 692, one frame of the terminal point of the limits of integration is updated, and it stores in Variable ZE.

[0058] Drawing 14 is a flow chart which shows one example of the detail of the average processing by the limits of integration of a zoom in drawing 2 .

[0059] In block 711, after breaking SGMZ by the limits of integration (ZE-ZS) and adding 1 to it, the scale factor of a zoom is stored in Variable Z.

[0060] Drawing 15 is a flow chart which shows one example of the detail of scale-factor registration processing of a zoom in drawing 2 .

[0061] Variable Z is registered into the term of Z to which it corresponds from the frame section ZS in the motion description table 18 of drawing 1 to ZE-1 in block 721. Next, the contents of the variable ZE are substituted for Variable ZS with block 722 for initialization of the following limits of integration. Moreover, Variable SGMZ is reset to 0 with block 723 for initialization of the following integral.

[0062] As mentioned above, as explained using drawing 1 - drawing 15 ,

according to the camera work detection approach of this example, camera works, such as a pan and a zoom, can be automatically described for every frame. Since much blocks have detected the motion vector at this time, it can become possible to remove beforehand the motion vector which has conflict statistically, and the dependability of the contents of description can be raised. Moreover, a motion parameter can perform detection of a motion parameter, even when it is the speed which he is trying to integrate with for every frame, and camera work carried out slowly. Moreover, in order to accelerate processing, an image may be thinned out in about 1/8 size for example, at the image input-process time. In this case, it will thin out, if detection precision becomes coarse and there is no motion of 8 pixels or more inter-frame, and it cannot detect on an image. However, a motion is detectable, while trying to find the integral for every frame and integrating with eight frames. Therefore, the usual workstation can also describe the camera work of a dynamic image at a practical rate.

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(54)【発明の名称】　カメラワーク検出方法

1

(57)【特許請求の範囲】

【請求項１】連続した複数の画像から構成される動画像をフレーム単位で時系列に入力し、
該フレーム間で、該フレームを小ブロックに分割したときのその小ブロック毎に定められた各代表点の動きベクトルを検出し、
各代表点の動きベクトルの平均値と標準偏差を求め、
該平均値から該標準偏差内にある各代表点の動きベクトルの平均値を求め、
求められた平均値を連続するフレームにおいて積分し、
積分された値が所定の閾値を越えたときにその値を積分区間で平均化し、
該平均化された値を該当するフレーム区間のパン及びチルトの動きパラメータとして、フレーム毎にカメラワークを記録する登録テーブルに出力することを特徴とするカメラワーク検出方法。

2

【請求項２】請求項１に記載のカメラワーク検出方法において、小ブロックの各代表点の動きベクトルは、連続するフレームの前のフレームで、画像のパターンが非一様なブロックを標準パターンとし、続くフレーム中の、上記ブロックの近傍で、該標準位置との差から求めるようにしたことを特徴とするカメラワーク検出方法。

【請求項３】連続した複数の画像から構成される動画像をフレーム単位で時系列に入力し、
該フレーム間で、該フレームを小ブロックに分割したときのその小ブロック毎に定められた各代表点の動きベクトルを検出し、
各代表点の動きベクトルと位置ベクトルとからズーム倍率を求め、
該ズーム倍率の平均値と標準偏差を求め、

該平均値から該標準偏差内にある各代表点のズーム倍率の平均値を求め、
求められたズーム倍率の平均値を連続するフレームにおいて積分し、積分された値が所定の閾値を越えたとき、その値を積分区間で平均化し、
該平均化された値を該当するフレーム区間のズームの動きパラメータとして、フレーム毎にカメラワークを記録する登録テーブルに出力することを特徴とするカメラワーク検出方法。
【請求項4】請求項3に記載のカメラワーク検出方法において、小ブロックの各代表点の動きベクトル、連続するフレームの前のフレームで、画像のパターンが非一様なブロックを標準パターンとし、続くフレーム中の、上記ブロックの近傍で、該標準位置との差から求めるようにしたことを特徴とするカメラワーク検出方法。
【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は、ビデオや映画の画像編集時に必要となる動画像のシーンの記述方法に係わり、特に、カメラのズーム（カメラのレンズの移動による撮像倍率の変化）やパンおよびチルトなど（カメラの左右および上下への回転移動）の動き情報に基づいて、ビデオテープやビデオディスクに格納された動画像から目的とする動画像フレームを検索し、画像編集を効率良く行なうのに好適なカメラワーク検出方法に関するものである。
【0002】
【従来の技術】従来、ビデオテープ等に格納された動画像から画像の変化点を自動検出することにより、シーンの変わり目を検出し、動画像編集時の頭だし操作などを容易にする技術が、例えば特願平２－２３０９３０に開示されている。この技術を用いて検出したシーン毎に、さらに、ビデオカメラ自体の動き、すなわち、ビデオカメラのズームやパンなどのカメラワークに関する情報を用いることにより、例えば、「右から左にパンしているシーンを見たい」、または、「ズームアップ直後のシーンを見たい」などの動画像の検索や、「パンの速度むらを修正したい」、「パンの速度をもっと速くしたい」などの動画像の編集作業を編集システムが支援することが可能になる。そのためには、ビデオカメラのズームやパンなどのカメラワークを検出して、それを自動的に記述しておく技術が必要となる。
【０００３】従来、ビデオカメラ自体の動きを検出する技術としては、例えば、特開平２－１５７９８０号公報に記載のものがある。これは、ビデオカメラの振動を検出して、画像ブレを補正するものである。すなわち、画面上で、比較的大きな検出領域を、例えば４個程度設定し、所定の偏移における相関値により、フレーム間の動きベクトルを求め、相関値の状態と、それ以前の動きベクトルの信頼性の判定結果とから画面の動きベクトルを決定する。ビデオカメラの振動による動きベクトルは０ベクトルを中心に振動し、移動物が侵入した場合は、移動物の動きとビデオカメラの動きが加算されて動きベクトルが求まる。この時の動きベクトルは振動による動きベクトルに一定値が加算されたものとなり、振動による動きベクトルとの分離が可能であり、振動による動きベクトルだけからビデオカメラの振動による画像のブレを補正するものである。
【0004】
【発明が解決しようとする課題】解決しようとする問題点は、従来の技術では、カメラ自体のゆっくりした動きを示す動きベクトルの検出を正確に行なうことができないために、パンやズームなどのカメラワークを自動的に検出することができず、効率の良い画像編集ができない点である。
【０００５】すなわち、特開平２－１５７９８０号公報に記載の装置は、ビデオカメラの振動検出が目的であり、パンやズームなどのカメラワークの検出目的には考慮が払われていない。例えば、右から左にビデオカメラをパンした画像に関しては、上述の装置では移動物が侵入したものと判定し、カメラの動きとは見なさない。また、ズームアップやズームダウン時の画像については、動きベクトルは画面中心から放射状の方向に検出されるが、それらの動きベクトルからズームの倍率値に変換する手段は無い。さらにパンやズーム時のビデオカメラの動きは、手振れの動きよりも速度が遅い。そのため、一回の動き検出で画面の動きを決定する上述の装置では十分な精度が得られない可能性が高い。
【０００６】本発明の目的は、このような従来の課題を解決し、速度の遅いパンやズームなどの画像からカメラの動きを検出して、目的とするパン動作およびズーム動作の変化点を自動的に検索でき、効率の良い画像編集を可能とするカメラワーク検出方法を提供することである。
【0007】
【課題を解決するための手段】上記目的を達成するため、本発明のカメラワーク検出方法は、（１）連続した複数枚の画像からなる動画像を、フレーム単位で時系列に入力し、このフレーム間で、小ブロック毎に定めたそれぞれの代表点の偏移量に対する相関値に基づき動きベクトルを検出し、この動きベクトルを用いて、カメラの動きを検出するカメラワーク検出方法において、任意の第１のフレームの代表点で検出した動きベクトルを用いて、もしくは、この動きベクトルと第１のフレームの直前に入力した第２のフレームの代表点の位置ベクトルとを用いて、カメラの動きを示す第１の動きパラメータを求め、この第１の動きパラメータを、フレーム毎に求め、かつ、予め任意に定めた許容値を越えるまで積分し、第１の動きパラメータの積分値が許容値を超えた時点で、この積分値を積分区間で平均して、この積分区間

のカメラの動きを示す第２の動きパラメータを算出し、この第２の動きパラメータに基づき、カメラの動きを検出することを特徴とする。

【０００８】また、（２）上記（１）に記載のカメラワーク検出方法において、第２のフレームで画像のパターンが非一様な小ブロックを標準辞書とし、この標準辞書に対応する第１のフレーム中の小ブロックの近傍で、この標準辞書のパターンと最も一致するパターンを求め、求めたパターンの第１のフレーム中での位置と、標準辞書の第２のフレームでの位置との差から動きベクトルを検出することを特徴とする。

【０００９】また、（３）上記（２）に記載のカメラワーク検出方法において、求めたパターンの第１のフレーム中での位置と、第２のフレームでの標準辞書の位置との差は、標準辞書のパターンの任意の位置の点を代表点として求めることを特徴とする。

【００１０】また、（４）上記（１）から（３）のいずれかに記載のカメラワーク検出方法において、小ブロック毎に定めたそれぞれの代表点の動きベクトルの方向と大きさの統計的な偏差を求め、予め任意に定めた許容範囲内の偏差を有する動きベクトルの平均値を算出し、この動きベクトルの平均値を用いて、第１の動きパラメータの内、カメラの回転運動に係わる動きを示すパラメータを求め、そして、小ブロック毎に定めたそれぞれの代表点の位置ベクトルの方向との差が予め任意に定めた許容範囲内の方向を有する動きベクトルを抽出し、抽出したこの動きベクトルと位置ベクトルとの内積をそれぞれに算出し、この内積と位置ベクトルの大きさとを加算した値を位置ベクトルの大きさで正規化して撮像倍率をそれぞれに求め、それぞれに求めた撮像倍率の統計的な偏差を求め、予め任意に定めた許容範囲内の偏差の撮像倍率の平均値を算出し、この撮像倍率の平均値を用いて、第１の動きパラメータの内、カメラのレンズ移動に係わる動きを示すパラメータを求めることを特徴とする。

【００１１】そして、（５）上記（１）から（４）のいずれかに記載のカメラワーク検出方法において、カメラの回転運動に係わる動きを示す第１の動きパラメータに基づく第２の動きパラメータ、および、カメラのレンズ移動に係わる動きを示す第１の動きパラメータに基づく第２の動きパラメータを、フレーム単位に、それぞれ分けて登録するテーブルに記述し、このテーブルを検索して、カメラの動きをフレーム単位に検出することを特徴とする。

【００１２】

【作用】本発明においては、カメラワークの変化を表すカメラのズームやパンの情報をフレーム毎に自動的に記述するために、カメラの回転運動のパラメータ推定（第１の動きパラメータ）、および、レンズ移動による撮像倍率のパラメータ推定（第１の動きパラメータ）を行なう。例えば、カメラの回転運動のパラメータ推定は、フレーム単位で時系列に入力して求めたブロック毎の動画像の動きベクトルを用いて行ない。また、カメラのレンズ移動による撮像倍率のパラメータ推定は、この動きベクトルと、代表点の位置ベクトルを用いて行なう。さらに、推定したパラメータをフレーム毎にそれぞれ積分し、積分した動きパラメータが予め任意に定めた許容値を越えるまで、この推定と積分処理を繰返し行なう。許容値を越えた時点で、積分値をその積分区間で平均し、この平均値をその積分区間での正式な動きベクトル（第２の動きパラメータ）とする。このことにより、カメラワークがゆっくりしたスピードの場合でも、カメラワークの検出に必要な動きベクトルを得ることができる。

【００１３】また、第１の動きパラメータの推定に用いるブロック単位の動きベクトルは、非一様なパターンを有するブロックのものを抽出し、誤検出の可能性が高くなるブロックを事前に除去する。さらに、動きパラメータの推定は、複数のブロックにおける動きベクトルの方向や大きさについての統計的な偏差を求め、量子化誤差やノイズにより本来あるべき方向からずれてしまった許容範囲外の動きベクトルについても予め除去することができる。

【００１４】さらに、このようにして得た信頼性の高いパンやズームのカメラの動き情報を、それぞれ各フレーム毎に自動的に記述し格納することができる。そして、格納したそれぞれの情報に基づき、目的とするパン動作およびズーム動作の変化点を検索し、効率の良い画像編集が可能となる。

【００１５】

【実施例】以下、本発明の実施例を、図面により詳細に説明する

【００１６】図１は、本発明の一実施例を示す動画像のカメラワーク検出システムの全体ブロック図である。

【００１７】本実施例のカメラワーク検出システムは、シーケンシャルにビデオデータを記録するビデオディスク装置（図中、ＶＤと記載）１０とビデオテープレコーダ１１（図中、ＶＴＲと記載）、および、一定速度で放送局等から一方的に送信（放送）されてくる画像を受信するテレビチューナ（図中、ＴＶＴと記載）１２からなる動画像入出力機器、これらの動画像入出力機器の制御および入力先の切り換えを行うビデオコントローラ１３、動画像がフレーム毎に格納されるフレームメモリ１４、システム全体の制御を行なう中央処理装置１５、中央処理装置１５で実行されるプログラムや、使用されるデータを格納するメインメモリ１６、そして、メインメモリ１６の容量を補充するための外部メモリである磁気ディスク装置１７により構成されている。

【００１８】そして、メインメモリ１６には、フレームメモリ１４に格納した動画像から動きベクトルを検出する動きベクトル検出プログラム（図中、検出Ｐｇｍと記載）２と、検出した動きベクトルからパンおよびズーム

の動きを示す動きパラメータ（すなわち、第１、２の動きパラメータ）の抽出処理を行なう動きパラメータ抽出処理プログラム（図中、抽出Ｐｇｍと記載）３と、抽出したパンおよびズームの動きを示す動きパラメータを、メインメモリ１６の動き記述テーブル１８に登録する登録処理プログラム（図中、登録Ｐｇｍと記載）４からなるカメラワーク検出・登録処理プログラム（図中、カメラワーク処理Ｐｇｍと記載）１が格納され、中央処理装置１５は、このカメラワーク検出・登録処理プログラム１に基づき、本発明に係わるカメラワーク検出および登録処理を行なう。

【００１９】ビデオディスク装置１０は、シーケンシャルにビデオデータを記録するが、ランダムアクセスが可能である。また、ビデオテープレコーダ１１は、シーケンシャルにビデオデータを記録し、アクセスもシーケンシャルアクセスであるが、スロー再生が可能である。そして、テレビチューナ１２は、記録が不可能であって、画像は一定速度で放送局等から一方適に送信（放送）されてくる。

【００２０】ビデオコントローラ１３は、中央処理装置１５の指令に基づき、ビデオディスク装置１０、ビデオテープレコーダ１１、テレビチューナ１２などの各種の動画像入出力機器の制御を行うと共に、それらの１つに、入力先を切り換えて接続し、動画像を取り込み、１フレームずつ、フレームメモリ１４に一時記憶する。

【００２１】そして、中央処理装置１５は、カメラワーク検出・登録処理プログラム１に基づき、フレームメモリ１４から読み出した動画像の動きを解析し、解析した中間データ、例えば、カットの変わり目間のシーン内における動画像の変化点、すなわち、パンおよびズームからなる動画像のカメラワークの情報を、フレーム毎に、メインメモリ１６の動き記述テーブル１８に記述する。尚、磁気ディスク装置１７にも動き記述テーブル１８を設け、カメラワークの情報を、メインメモリ１６に一旦格納した後、磁気ディスク装置１７に登録しても良い。

【００２２】このようにして、カメラワークの情報を記述した動き記述テーブル１８を用いることにより、本実施例のカメラワーク検出システムでは、例えば、「右から左にパンしているシーンを見たい」、または、「ズームアップ直後のシーンを見たい」などの動画像の検索や、「パンの速度むらを修正したい」、「パンの速度をもっと速くしたい」などの動画像の編集作業を支援することが可能になる。尚、動き記述テーブル１８に記述しておくのではなく、例えば、パンやズームを示す動きベクトル量を予め指定しておき、入力されてくる動画像の動きベクトルを、比較しながらカメラワークを検出する操作も可能である。

【００２３】このように、本実施例のカメラワーク検出システムでは、特別なハードウェア構成は設けておらず、ＡＶ機器（音声映像機器）とワークステーションなどの装置で容易に構成することができる。以下、本実施例のカメラワーク検出システムによる本発明に係わる処理動作を詳しく説明する。

【００２４】図２は、図１における中央処理装置の本発明に係わるカメラワーク検出処理動作を示すフローチャートである。

【００２５】図１の中央処理装置１５による、カメラワークの動きパラメータの検出動作、および、この検出による動画像のフレーム毎の動きの記述動作を示す。

【００２６】初期化処理（ボックス６０）で、各種変数に初期値を付与する。初期化処理の詳細は、図６で述べる。次に、画像入力処理（ボックス６１）では、動画像を１フレーム（すなわち、第１のフレーム）だけフレームメモリ１４に取り込む。この時の画像をＰｎとした時、フレームメモリ１４の中には、一つ前のフレーム（すなわち、第２のフレーム）の画像Ｐn_{-1}も格納しておく。そして、動きベクトル検出処理（ボックス６２）では、画像を多数のブロックに分割し、そのブロック毎に動きベクトル（すなわち、第１の動きパラメータ）を計算する。ここではブロックの中心位置の点の動きベクトルを求める。この動きベクトル検出処理の詳細は、図７で後述する。このようにして、ブロック毎に求めた動きベクトルを用い、図１の中央処理装置１５は、図１のカメラワーク検出・登録処理プログラム１に基づき、本発明に係わるパンの動き、および、ズームの動きに対する検出および登録処理を行なう。

【００２７】すなわち、パンの動き検出処理（ボックス６３）で、ブロック毎に求めた動きベクトルを統計的に処理して、異常な動きベクトルは除外した上で、パンの動きパラメータを計算する。このことにより、検出した動きベクトルの信頼性を高める。尚、パンの動き検出処理の詳細は、図８で述べる。次に、積分処理（ボックス６４）では、フレーム毎にパンの動きパラメータを積分する。これにより、速度の遅いパンも正確に検出できるようになる。積分処理の詳細は図９で述べる。さらに、判断ボックス６５では、積分結果の絶対値が所定の閾値αを超えた時点を検出する。もし超えた場合、積分区間での平均処理（ボックス６６）で、積分結果を積分区間で所要したフレーム数で割ることにより、積分区間での平均値を求める。そして、パンの動き登録処理（ボックス６７）で、図１のメインメモリ１６内の動き記述テーブル１８に、この平均値からなるパンの動きパラメータ（すなわち、第２の動きパラメータ）を書き込む。尚、登録終了後積分処理のための各種変数は初期化しておく。また、これらの積分区間での平均処理、および、パンの動き登録処理の詳細は、それぞれ、図１０、図１１で説明する。

【００２８】次に、ズームの倍率検出処理（ボックス６８）では、ブロック毎に求めた動きベクトルと位置ベクトルを統計的に処理して、異常な動きベクトルを除外し

た上で、ズームの倍率パラメータを計算する。このズームの動き検出処理の詳細は、図１２で述べる。さらに、積分処理（ボックス６９）では、フレーム毎にズームの倍率パラメータを積分する。これにより、速度の遅いズームも正確に検出できるようになる。積分処理の詳細は、図１３で述べる。尚、ズームしていない状態では倍率パラメータは「１」となるので、積分は倍率パラメーター「１」の値を用い、これを次の処理に利用する。判断ボックス７０では、積分結果の絶対値が所定の閾値βを超えた時点を検出し、もし超えた場合、積分区間で平均を求め、ズームの倍率パラメータを図１の動き記述テーブル１８へ登録する。すなわち、積分区間での平均処理（ボックス７１）で、積分結果を積分区間で所要したフレーム数で割ることにより平均値を求め、ズームの倍率登録処理（ボックス７２）で、図１のメインメモリ１６内の動き記述テーブル１８にズームの倍率パラメータを書き込む。尚、登録終了後に、積分処理のための各種変数は初期化しておく。また、これらの積分区間での平均処理、および、ズームの倍率登録処理の詳細は、それぞれ、図１４、図１５で述べる。

【００２９】このようにして、一フレーム分におけるパンの動き登録処理とズームの倍率登録処理が終了すると、フレーム更新処理（ボックス７３）を行ない、ボックス６１からボックス７２までの処理を繰返し、次のフレームに対して、パンの動き登録処理とズームの倍率登録処理を行なう。尚、図１の動き記述テーブル１８を図１のメインメモリ１６に格納する時に、フレーム数が大きくなる場合は、外部メモリである図１の磁気ディスク１７に格納するようにしても良い。

【００３０】次に、パンおよびズームの動き検出方法に関して説明する。

【００３１】図３は、図１におけるカメラワーク検出システムで検出するカメラワークの透視変換モデルの一実施例を示す説明図である。

【００３２】図３において、符号２０、２１、２２は空間の直交座標系の軸であり、それぞれＸ軸２０、Ｙ軸２１、Ｚ軸２２である。また符号２３は画像面であり、この画像面２３の画像原点ｏをＺ軸２２が貫き、かつ、垂直になるような平面とする。ｆは直交座標系の原点Ｏと画像面２３との距離であり、焦点距離と呼ぶ。また、原点Ｏは視点と呼ぶ。この透視変換モデルでは、空間中の点Ｐ（Ｘ，Ｙ，Ｚ）は、この点Ｐと原点Ｏを結ぶ直線の画像面２３との交点ｐに投影される。その点ｐの画像座標を（ｘ，ｙ）とすれば、透視変換モデルの幾何学的関係から、

$$x = (f \times X) \div Z \quad , \quad y = (f \times Y) \div Z \qquad (数１)$$

となる。このモデルによれば、パンと呼ぶカメラワークは、Ｘ軸２０またはＹ軸２１を回転させる運動であり、ズームと呼ぶカメラワークは、画像面２３のＺ軸２２の平行移動の運動である。まず、パンの動き、例えば、Ｙ軸２１を回転させる運動に関しての説明を行なう。

【００３３】図４は、図１におけるカメラワーク検出システムのパンの動き検出動作の一実施例を示す説明図である。

【００３４】図３および図４（ｂ）で示すＹ軸２１回りの画像面２３の回転による画像面２３上の動きベクトルの例を示し、図４（ａ）において、各ブロック３０の動きベクトル（図中の矢印）は、ほぼ同じ大きさのものが同じ方向を向く。図４（ｂ）では、Ｙ軸２１回りに、Δθだけ、座標系が回転した場合の点ｐ（ｘ，ｙ）の動きベクトルｖ（ｖｘ，ｖｙ）を示している。

【００３５】ここで、点ｐのＸ軸方向の動きベクトル成分ｖｘは、図４（ｂ）により、

$$vx = f \times (\tan(\theta + \Delta\theta) - \tan\theta) \qquad (数２)$$

となる。ここで、θは、点ｐの原点Ｏからの位置ベクトルのＹＺ平面とのなす角度であり、ｔａｎθ＝ｘ÷ｆである。そこで、数２を変形すると、

$$vx = f \times ((\tan\theta + \tan\Delta\theta) \div (1 - \tan\theta \times \tan\Delta\theta) - \tan\theta) \qquad (数３)$$

となる。ここで、焦点距離ｆが画像面２３のサイズより十分大きい時、数３は、

$$vx \fallingdotseq f \times \tan\Delta\theta \qquad (数４)$$

で近似できる。したがって、動きベクトルｖを求めることによってカメラの回転速度が間接的に求められる。

【００３６】次に、ズームの動き、すなわち、画像面２３のＺ軸２２の平行移動の運動に関しての説明を行なう。

【００３７】図５は、図１におけるカメラワーク検出システムのズームの動き検出動作の一実施例を示す説明図である。

【００３８】図３において、原点ＯからＺ軸２２方向への画像面２３の平行移動Δｆによる画像面２３上の動きベクトルの例を示し、各ブロック３０の動きベクトルは、画像原点ｏから放射状の方向に、画像原点ｏからの距離に比例して大きくなる。ここで、ズームの倍率ｚは、

$$z = (f + \Delta f) \div f \qquad (数５)$$

であり、図３の透視変換モデルにより、焦点距離ｆの時の画像面上での点ｐの位置ベクトルｐｖ１（ｘ１，ｙ１）と、焦点距離ｆ＋Δｆの時の点ｐの位置ベクトルｐｖ２（ｘ２，ｙ２）から、その絶対値を用いて、

$$z = \| pv2 \| \div \| pv1 \| \qquad (数６)$$

でも記述できる。数６は、さらに画像面上での点ｐの動＊＊きベクトルｖを用いて、

$$z = \| pv1 + v \| \div \| pv1 \| \quad (数7)$$

で記述できる。また、本実施例では、動きベクトルｖがノイズ等で誤差を持つ可能性があるので、位置ベクトル※※ｐｖ１と方向が同じ成分の大きさだけを加算するようにしている。すなわち、

$$z = ((\| pv1 \|) + (v \cdot pv1)) \div \| pv1 \| \quad (数8)$$

でズーム倍率を求める。

【００３９】次に、図２で説明した図１におけるカメラワーク検出システムの各処理ボックスの詳細を説明する。

【００４０】図６は、図２における初期化処理の詳細の一実施例を示すフローチャートである。

【００４１】ボックス６０１で、各種変数の初期値を０にリセットする。すなわち、パンの動きパラメータの積分用のワークエリアを意味する変数ＳＧＭＶＸおよびＳＧＭＶＹと、ズーム倍率の積分用のワークエリアを意味する変数ＳＧＭＺと、フレーム番号を意味する変数ｎと、パンの動きパラメータの積分区間の始点と終点のフレーム番号を意味する変数ＰＳおよびＰＥと、ズーム倍率の動きパラメータの積分区間の始点と終点のフレーム番号を意味する変数ＺＳおよびＺＥを、全て「０」にする。

【００４２】図７は、図２における動きベクトル検出処理の詳細の一実施例を示すフローチャートである。

【００４３】先ず、ボックス６２１で、動きベクトル検出フラグＦｋを０にリセットする。これはブロックｋでの動きベクトルの検出がされなかった状態である。次に、ボックス６２２では、ブロックｋが、動きベクトル検出に適しているかどうかを判定する。すなわち、本発明では、動きベクトル検出に、パターンマッチングによる相関値を用いているので、ブロック内が一様な濃度のパターンでは、たとえ相関値が低くても信頼性はない。そこで、事前に、ブロック内に縦、横、斜めのパターン成分が一定値以上含まれているかどうかをチェックする。

【００４４】ブロック６２３では、ブロック内に縦、横、斜めのパターン成分が一定値以上含まれ、パターンが非一様であるかどうかをチェックする。そして、パターンが非一様であると判定すると、ブロック６２４で、パターンマッチングによる動きベクトルの検出を行う。すなわち、ブロック６２４では、１フレーム前の画像Ｐｎ−1のブロックｋのパターンを標準辞書として、画像Ｐｎ中で最小となる相関値Ｍｉｎと、その時の偏移ΔＸｋとΔＹｋを求める。そして、ブロック６２５では、最小となる相関値が、閾値γより小さいことを判定する。小さければ、ボックス６２６で、動きベクトル検出フラグＦｋを１にセットし、ブロックｋで、動きベクトルが求まった状態にする。

【００４５】以上のことを全てのブロックｋについて行うと、画面の各ブロックで、多数の動きベクトルが得られることになる。このように、本実施例では、動きベクトルを求める前に、ブロック内のパターンのチェックを行っているので、信頼性の高い動きベクトルが求まる。また、パターンマッチングによる動き検出であるので、ノイズに対しても安定に動作する。

【００４６】図８は、図２におけるパンの動き検出処理の詳細の一実施例を示すフローチャートである。

【００４７】先ず、ブロック６３１では、各ブロックで求めた動きベクトルの平均（ＡＶＥＶＸ，ＡＶＥＶＹ）と、標準偏差（ＳＴＶＸ，ＳＴＶＹ）を計算する。次に、ブロック６３２で、各ブロックで求められた動きベクトルから、この平均から標準偏差内に入っている動きベクトルを求める。そして、ブロック６３３では、平均から標準偏差内に入っている動きベクトルについて、平均を求め、パンの動きベクトル（ＶＸ，ＶＹ）とする。このように本実施例では、単純な平均ではなく、異常な動きベクトルを除いた上で平均化しており、得られる動きベクトルの信頼性は高くなる。また、画面中に移動物体が現われても、全画面の半分以下であればその影響はない。

【００４８】図９は、図２におけるパンの動き積分処理の詳細の一実施例を示すフローチャートである。

【００４９】ブロック６４１で、積分結果をＳＧＭＶＸ、ＳＧＭＶＹに格納し、ブロック６４２で、積分区間の終点のフレームを１つ更新し、変数ＰＥに格納する。

【００５０】図１０は、図２におけるパンの積分区間での平均処理の詳細の一実施例を示すフローチャートである。

【００５１】ブロック６６１においては、積分区間（ＰＥ−ＰＳ）で、ＳＧＭＶＸ、ＳＧＭＶＹを割り、パンの動きパラメータを変数ＤＸ、ＤＹに格納する。

【００５２】図１１は、図２におけるパンの動き登録処理の詳細の一実施例を示すフローチャートである。

【００５３】ブロック６７１で、変数ＤＸ、ＤＹを、図１の動き記述テーブル１８におけるフレーム区間ＰＳからＰＥ−１までの該当するＤＸ、ＤＹの項に登録する。次に、ブロック６７２で、次の積分区間の初期化のため、変数ＰＳに変数ＰＥの内容を代入する。そして、ブロック６７３で、次の積分の初期化のため、変数ＳＧＭＶＸ、ＳＧＭＶＹを０にリセットする。

【００５４】図１２は、図２におけるズームの倍率検出処理の詳細の一実施例を示すフローチャートである。

【００５５】ブロック６８１では、各ブロックの中心の点の位置ベクトルと、それに対応する動きベクトルから、数式８により、ズームの倍率Ｚｋを計算する。尚、この時、動きベクトルの方向と、位置ベクトルの方向が

大幅にずれている場合は、異常な動きベクトルと判断し、ズームの倍率計算は行わない。また、ズームの倍率Ｚｋは、値１を中心に、ズームアップ時には１より大きくなり、ズームダウン時には１より小さくなる。次に、ブロック６８２では、各ブロックで求めたズーム倍率Ｚｋの平均と標準偏差を計算し、変数ＡＶＥＺ、ＳＴＶＺにそれぞれ格納する。そして、ブロック６８３で、各ブロックで求めたズーム倍率Ｚｋが、この平均から標準偏差内に入っているものについてのみ平均を求め、ズーム倍率Ｚとする。このように本実施例では、ズームの検出についても、単純な平均ではなく、異常なズーム倍率を除いた上で平均化しており、得られるズーム倍率の信頼性は高くなる。また、パンの検出の場合と同様に、画面中に移動物体が現われても、全画面の半分以下であればその影響はない。

【００５６】図１３は、図２におけるズームの倍率積分処理の詳細の一実施例を示すフローチャートである。

【００５７】ブロック６９１で、積分結果を変数ＳＧＭＺに格納するが、この際、ズーム倍率Ｚから１を差し引いたものを積分する。次に、ブロック６９２で、積分区間の終点のフレームを１つ更新し、変数ＺＥに格納する。

【００５８】図１４は、図２におけるズームの積分区間での平均処理の詳細の一実施例を示すフローチャートである。

【００５９】ブロック７１１では、積分区間（ＺＥ－ＺＳ）でＳＧＭＺを割り、それに１を加算した後、ズームの倍率を変数Ｚに格納する。

【００６０】図１５は、図２におけるズームの倍率登録処理の詳細の一実施例を示すフローチャートである。

【００６１】ブロック７２１では、変数Ｚを、図１の動き記述テーブル１８におけるフレーム区間ＺＳからＺＥ－１までの該当するＺの項に登録する。次に、ブロック７２２で、次の積分区間の初期化のため、変数ＺＳに変数ＺＥの内容を代入する。また、ブロック７２３で、次の積分の初期化のため、変数ＳＧＭＺを０にリセットする。

【００６２】以上、図１～図１５を用いて説明したように、本実施例のカメラワーク検出方法によれば、パンやズームなどのカメラワークを、フレーム毎に自動的に記述することができる。この時、動きベクトルを多数のブロックで検出しているので、統計的に矛盾のある動きベクトルを、予め除去することが可能となり、記述内容の信頼性を向上させることができる。また、動きパラメータは、フレーム毎に積分するようにしており、カメラワークがゆっくりしたスピードの場合でも、動きパラメータの検出ができる。また、処理を高速化するためには、たとえば画像入力処理時点で、画像を１／８程度のサイズに間引いても良い。この場合、検出精度が粗くなり、フレーム間で８画素以上の動きがなければ間引き画像上では検出できない。しかしながら、フレーム毎に積分するようにしており、８フレーム積分する間に、動きが検出できる。従って、通常のワークステーションでも、実用的な速度で、動画像のカメラワークを記述することができる。

【００６３】

【発明の効果】本発明によれば、パンやズームなどのカメラワークを、たとえ移動物体が画面に侵入しても正確に検出でき、かつ、通常のワークステーションでも高速に検出して記述することが可能となり、このカメラワークの記述データを、ビデオ編集時の動画像の検索やパンなどの速度調整作業の情報として有効に利用することができ、画像編集処理操作の向上が可能となる。

【００６４】

【図面の簡単な説明】

【図１】本発明の一実施例を示す動画像のカメラワーク検出システムの全体ブロック図である。

【図２】図１における中央処理装置の本発明に係わるカメラワーク検出処理動作を示すフローチャートである。

【図３】図１におけるカメラワーク検出システムで検出するカメラワークの透視変換モデルの一実施例を示す説明図である。

【図４】図１におけるカメラワーク検出システムのパンの動き検出動作の一実施例を示す説明図である。

【図５】図１におけるカメラワーク検出システムのズームの動き検出動作の一実施例を示す説明図である。

【図６】図２における初期化処理の詳細の一実施例を示すフローチャートである。

【図７】図２における動きベクトル検出処理の詳細の一実施例を示すフローチャートである。

【図８】図２におけるパンの動き検出処理の詳細の一実施例を示すフローチャートである。

【図９】図２におけるパンの動き積分処理の詳細の一実施例を示すフローチャートである。

【図１０】図２におけるパンの積分区間での平均処理の詳細の一実施例を示すフローチャートである。

【図１１】図２におけるパンの動き登録処理の詳細の一実施例を示すフローチャートである。

【図１２】図２におけるズームの倍率検出処理の詳細の一実施例を示すフローチャートである。

【図１３】図２におけるズームの倍率積分処理の詳細の一実施例を示すフローチャートである。

【図１４】図２におけるズームの積分区間での平均処理の詳細の一実施例を示すフローチャートである。

【図１５】図２におけるズームの倍率登録処理の詳細の一実施例を示すフローチャートである。

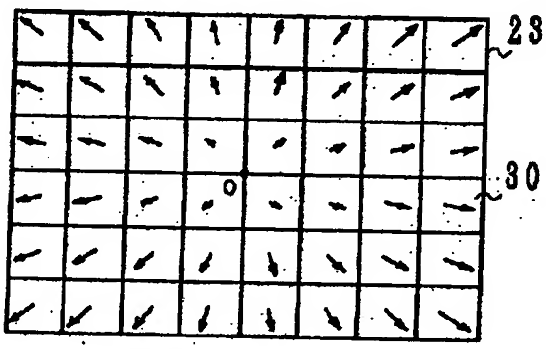
【符号の説明】

1　カメラワーク検出・登録処理プログラム
2　動きベクトル検出プログラム
3　動きパラメータ抽出処理プログラム

4　登録処理プログラム
10　ビデオディスク装置
11　ビデオテープレコーダ
12　テレビチューナ
13　ビデオコントローラ
14　フレームメモリ
15　中央処理装置
16　メインメモリ
＊17　磁気ディスク装置
18　動き記述テーブル
20　X軸
21　Y軸
22　Z軸
23　画像面
30　ブロック
＊

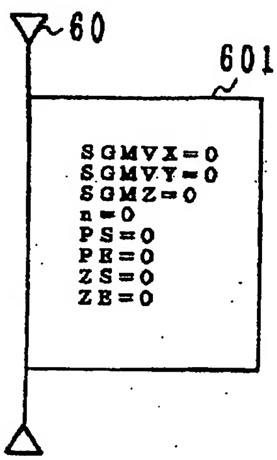
【図5】

Z軸Δf平行移動時の動きベクトル

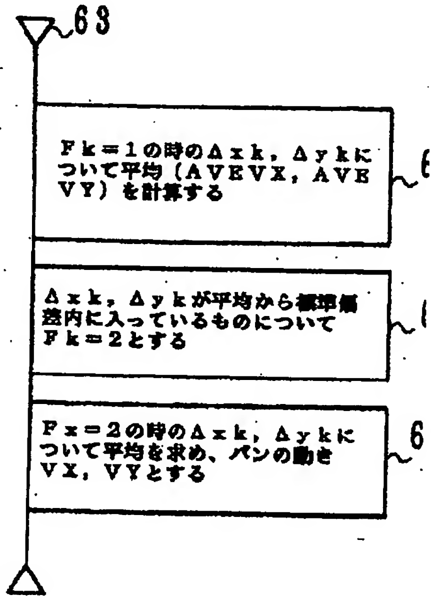


【図6】

初期化処理

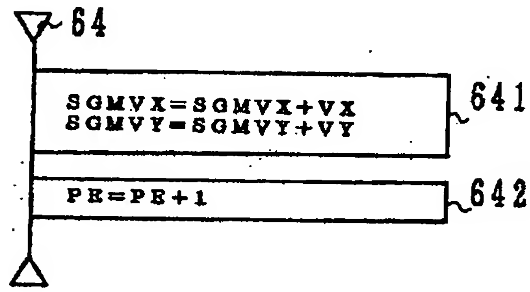


【図8】



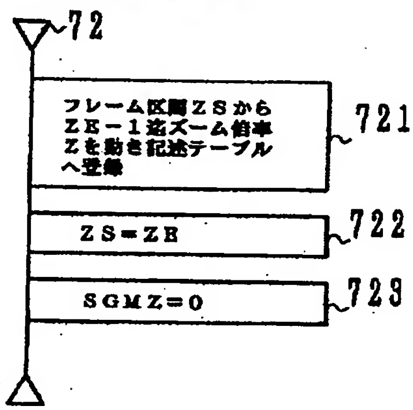
【図9】

パンの動き積分処理

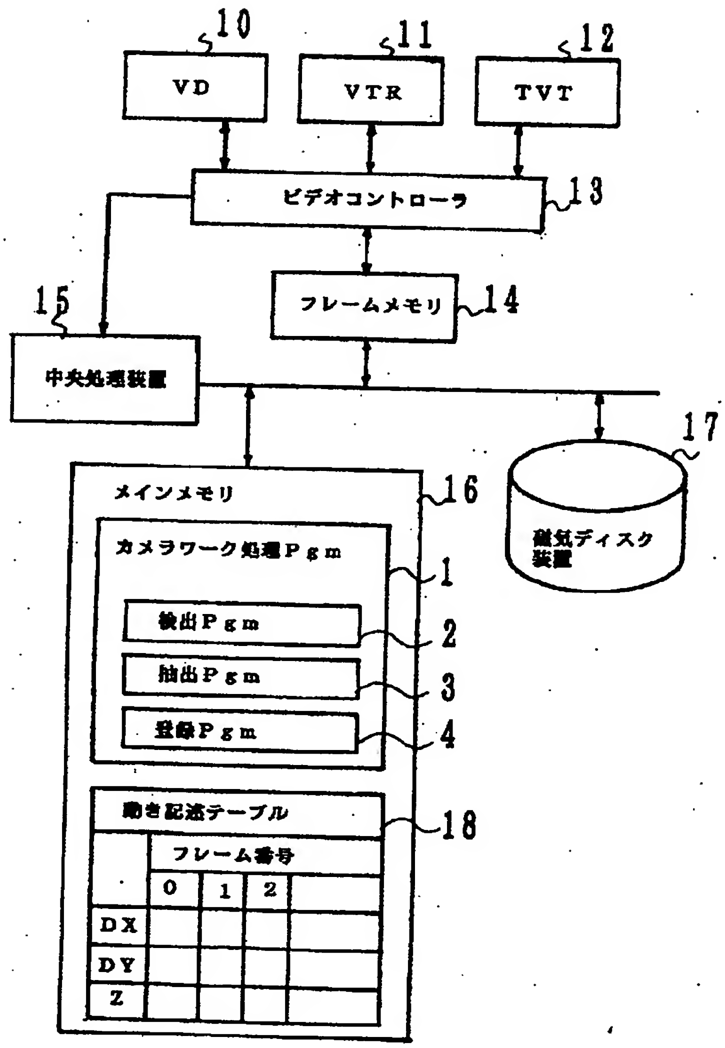


【図15】

ズームの倍率登録処理

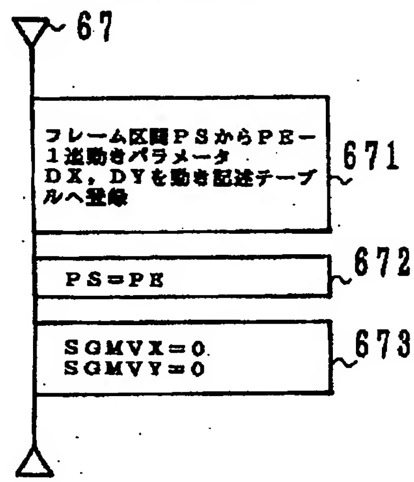


【図1】



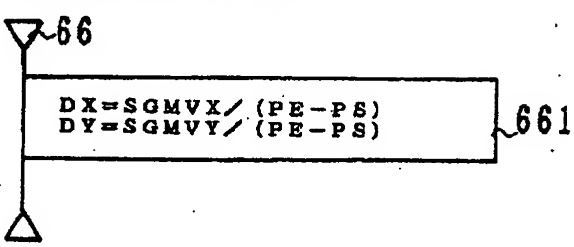
【図11】

パンの動き登録処理



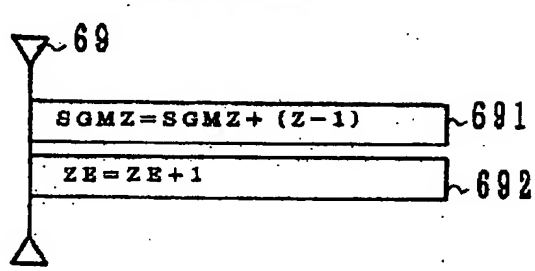
【図10】

パンの積分区間での平均処理



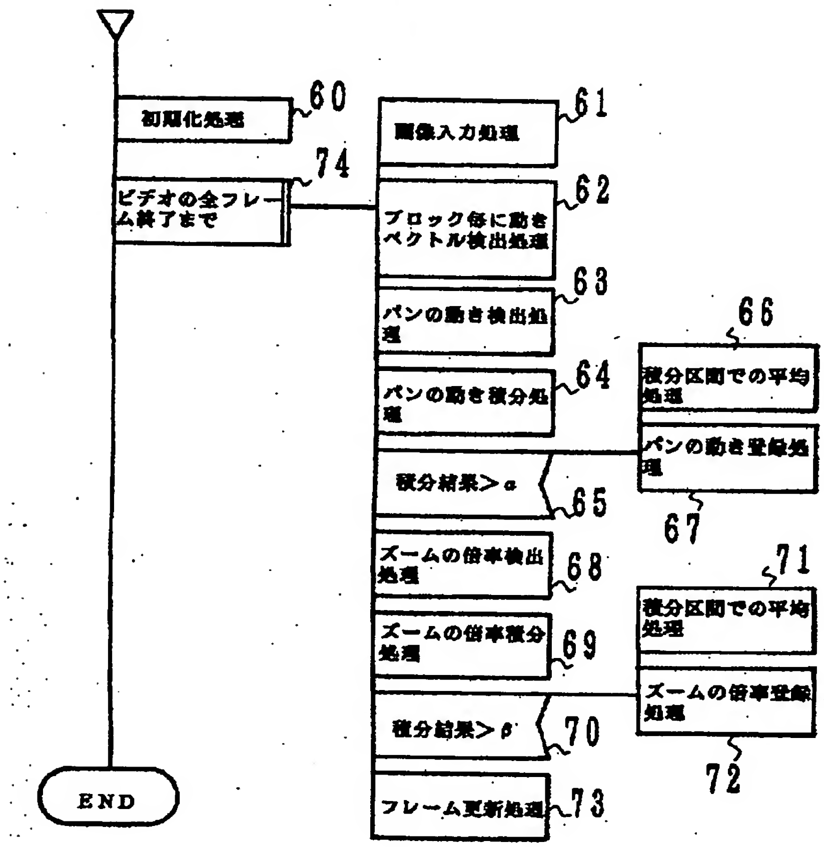
【図13】

ズームの倍率積分処理



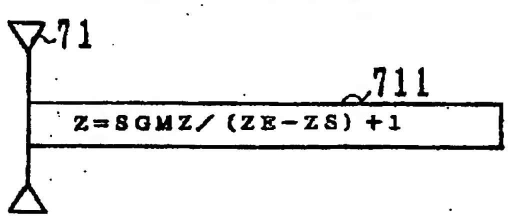
【図２】

カメラワーク検出処理



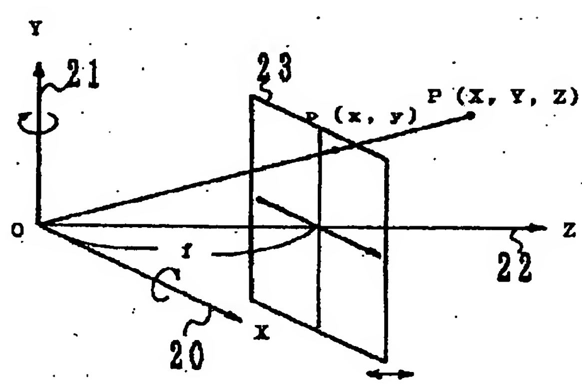
【図１４】

ズームの積分区間での平均処理



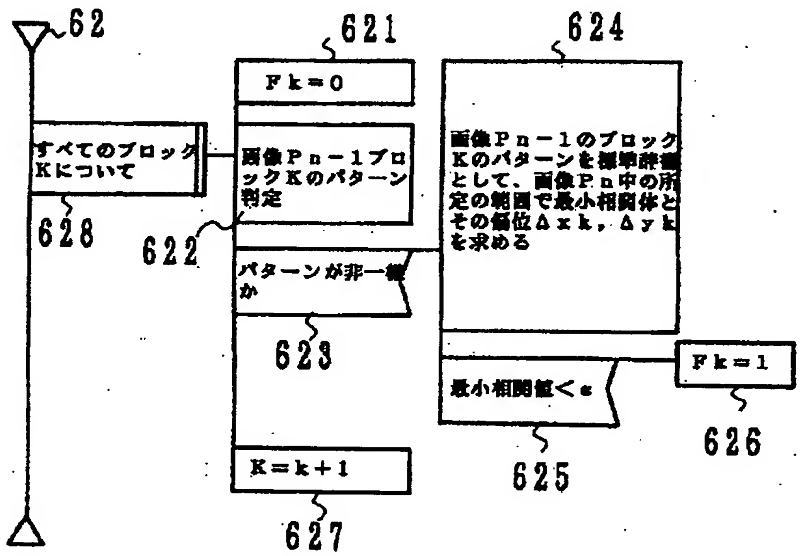
【図３】

透視変換モデル



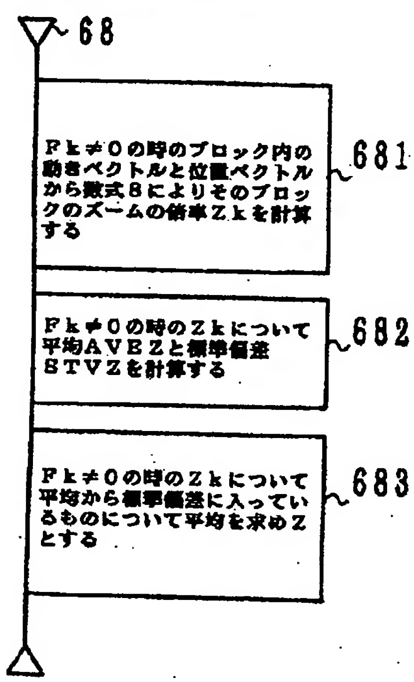
【図７】

動きベクトル検出処理



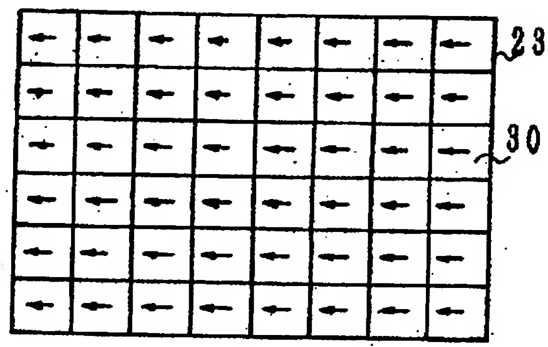
【図１２】

ズームの倍率検出処理



【図4】

(a) Y軸Δθ回転時の画像面の動きベクトル



(b) Y軸Δθ回転時の動きベクトル